DISCOVER DIVING

The Diver's Journal

December 1990
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The Solomon Islands
Above and Below

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- Hawaii's Kaua'i
- Sea of Cortez
- USS San Diego

Gill Nets
A Tangled Controversy

Dive Computers
High Altitude Comparison

New **Decompression Theory**

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No decompression limit (scrolling)	-	•	•
Deepest decompression stop	-	•	•
Alarm indicating contravention of decompression	-	•	•(1)
Desaturation time	-	•	•
Altitude sector (if at high altitude)	-	•	•
High altitude adaption time	-	•	•
Tissue number indi'cator for incomplete decompression	-	•	•
Operating mode indicator	-	•	•
Low battery warning	-	•	•
No flying indicator	-	-	•
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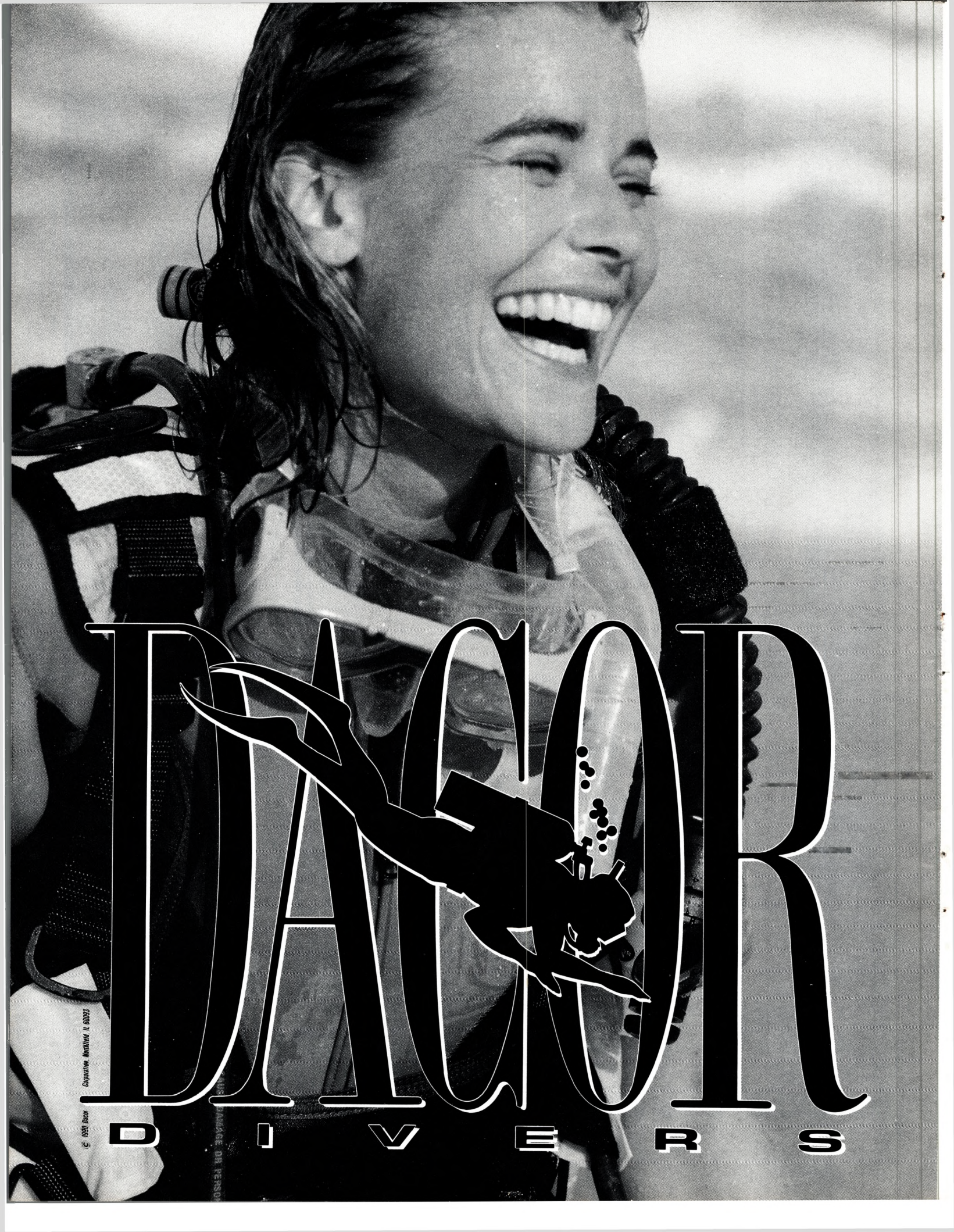
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DISCOVER DIVING

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ON THE COVER

Photo by Ken Loyst • This issue's cover features Pat van Mullem swimming into a cave in the Solomon Islands. The photo was taken by Ken using a Nikonos V with a 15mm lens, and 2 MCD strobes with diffusers. The film he used was Fujichrome 100, an aperture set on f4, with a 1/60 exposure.

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How Do We Decompress?

Part 2

by Tabby Stone, M.D.

Multi-Level Diving

In basic courses, divers are taught to calculate dive profiles as if the entire dive is spent at the deepest depth. Often only a small portion of the dive was at that depth. This is a very conservative method of diving which should increase safety. Less nitrogen is added to the body load at shallower depths during the allowable dive time and some tissue groups may be decompressing during the course of the dive. The only problem with this method is a decrease in the time a diver spends in the water.

In 1976 Graver published a method of calculating multi-level dives and commercial divers had devised similar methods around the same time. The diver planned his dive as a deep portion for a certain number of minutes followed by a shallow portion. This single dive was calculated with the tables as if two separate dives were done with no surface interval between them and the repetitive groups used as a "table of equivalents." For example, a dive might be done on a wall to 90 feet for 15 minutes followed by an ascent to a reef above the wall at 20 feet for 45 minutes. This would normally be considered a gross violation of the Navy tables. Multi-level diving techniques are used by an unknown number of sport divers. They have been a common technique at some Caribbean dive resorts. While multi-level calculations are not terribly difficult to do for those well trained in manipulating the Navy tables, they are not suggested for novices. The technique has never been rigorously tested in sport divers but it seems to work well when properly used. The theory on which multi-level diving is based is a reasonable one overall, but there is a possibility of getting into decompression trouble on some dive profiles. The Navy Table repetitive dive groups are based only on the 120 minute half time compartment and some profiles could cause some faster compartments to become saturated beyond their limits.

Meters and Computers

Monitoring of decompression status is going high tech. Until a few years ago, most divers calculated their allowable bottom times with the relatively inexpensive combination of a depth gauge, a watch and a set of dive tables. Now more and more divers are spending hundreds of dollars for an electronic instrument to monitor their dives.

Beginning in the 1950's attempts were made at producing meters for monitoring decompression status. Over the next thirty years a number of devices were developed and a few types commercially sold. Until the 1980's with the advent of micro-electronic technology, none of the meters designed were both practical for sport diving and based on tables which allowed for safe multiple dives.

The modern computerized meters combine an electronic timer and an electronic depth gauge which are generally more accurate than the mechanical gauges used previously with a chip containing a set of instructions on how to calculate the decompression status. The resulting calculations are then displayed on the meter. The calculations may be updated every few seconds.

As explained in Part 1, there are a number of models of how decompression works in the body. Tables from each of the models are based on calculations comparing the excess nitrogen buildup in a theoretical tissue group with the amount of nitrogen that model of decompression assumes the tissue can handle after ascent.

Computers can either compare the depth and time of a dive to a table in the chip or actually do the same type of calculations used to create dive tables every few seconds. Dive tables average out depths and times to the nearest minute and the nearest ten feet in order to give a number of combinations of depth and time that a diver can work with. Computers can handle information more rapidly and the instruction set (algorithm) may make calculations based on the nearest half foot. Instead of having the 1356 possible combinations of depth and times used in the Navy No-Decompression tables, a computer creates the equivalent of a table with many thousands of possible combinations.

Technically, the computers which do calculations are model- or algorithm-based. Since tables are generally created from the same models, the computers are often referred to as based on those tables. For example, a Swiss or Buehlmann model-based computer may be said to be based on the Swiss tables.

Models are all mathematical representations of how the body seems to handle decompression. There is no single "right" way to represent what happens in the body and no standard exists for what decompression model should be used in dive computers. Each manufacturer has chosen what it considers the appropriate method. Some of the older computers used standard Navy tables and gave no credit for time spent at shallower depths. Most manufacturers now use one of the more conservative decompression models. These allow less time at any single depth, but with multi-level calculations, credit for time spent at shal-

Multi-level Diving, Meters & Computers

lower depths may allow a longer total dive time. Multi-level calculations with the computer are similar in concept to those in Graver's method but have been considerably improved. They essentially give a continuous decompression by recalculating the diver's limits every few seconds against as many as 12 tissue compartments at a time.

Depending on the decompression model chosen by the manufacturer there will be differences between computers in the amount of time allowed at depth and the time allowed on repetitive dives. A comparison between brands can be found in the series of articles by Ken Loyst in the last few issues of ***Discover Diving***.

The more conservative limits in many computers are based on models designed to eliminate even so called "silent bubbles" and should be safer than Navy tables. The slow decompression produced in a continuously calculated multi-level profile and the slower ascent times allowed by the computers should increase safety.

But, with multi-level techniques more time is spent in the water and often less surface interval is required, more dives and longer total bottom time may be allowed. This may be more hazardous.

DAN (Divers Alert Network) collects reports of dive accidents. Their statistics show that a higher percentage of DCS cases occur after diving which is deeper, multi-level, repetitive and on multiple days. While the total number of reported DCS cases per year remains around 550-600, the percentage of cases involving divers using computer are rising.

These days more of the divers doing deep, multi-level, multi-day repetitive diving are using computers. The type of diving is probably more significant than the method of calculating decompression status. As more computers are used, it is not surprising that the percentage of DCS cases in divers using computers has risen.

How Can You Use Your Computer Safely?

First, read the manual and learn to use your chosen type of computer properly. Take a class if necessary.

Make sure the computer is turned on when you get in the water and remember to read it and follow its guidelines. There have been a number of cases of DCS where people had computers but didn't bother to turn them on or use them.

Computers do not change physiology. The "rules" for safe diving which were taught for years before the advent of these automated meters still hold true. Trade names aside, no decompression device has a brain. The only brain involved is that of the diver.

Computers add and subtract nitrogen loading from various compartments and know the current result but don't "remember" what dive profile gave that result. The deepest dive of the day should be done first and the deepest part of any dive should always be done first. The display on a computer may show that a dive can be made to 120 feet for several minutes shortly after surfacing from a near limit dive to 60 feet. The diver has to realize that no matter what the display shows, this is a stupid idea. ORCA suggests not making a repetitive dive deeper than 80 feet with a surface interval less than one hour despite what the display shows.

Ascend slowly and watch the ascent rate warnings on your computer. Different computers have different maximum ascent rates incorporated in their design. Ascending faster than the suggested rate means the diver is not following the assumptions made by the computer and may increase risk.

Computers act like a form of tables. Divers have always been taught not to "push the limits" when diving with written tables and shouldn't push them when using computer calculations. Some experts suggest never getting closer than five minutes to the "No-stop" limit. In this way, you add safety and will never be required to have a decompression stop in case an emergency causes you to cut a dive short.

Make a safety stop. With tables or computers a stop at 10-15 feet for at least two to five minutes is a good idea.

Don't completely trust your computer. It is a complicated electronic instrument in a hostile environment. Batteries can burn out, leakage can occur and electronics can fail. Many experts suggest backup gauges. If your computer fails, abort the dive. What to do after that dive is a major problem. With most computers there is no way to re-enter the Navy tables and you are still on the computer's tables for up to 48 hours with some brands. The safest thing to do is to sit out that time.

There is a method developed by Michael Emmerman for re-entering the Huggins "No-Bubble" tables if a malfunction of an ORCA computer (Edge, Skinny Dippper, Sigmatech, or Delphi) occurs. It is an experimental method, not tested in divers and not guaranteed in any way. It requires recording the entire set of allowable next dives before and after each dive. The method should work if a diver is compulsive enough to do the record keeping. In my experience, most divers with computers become very sloppy about logging dives and would be unlikely to be able to use this technique.

There is no completely safe method of diving without risk of DCS. Rarely bends occurs well within the Navy table limits and cases happen even within the more conservative limits of the computers.

We do not know the true incidence of DCS in sport divers. It is relatively easy to find out how many cases are treated, but virtually impossible to know how many dives are made overall. All estimates show that the incidence seems to be very low.

No table has been scientifically tested on large numbers of divers at every possible dive profile. Even the Navy tables which have been in common use for over thirty years were not completely tested.

There is no absolute right way to decompress. The current generation of computers all appear to be safe guides for determining how long a diver many stay at depth. Dive tables, either the U.S. Navy tables or other newer ones are still an acceptable method of calculating dive profiles when used properly and conservatively. Just remember that for the most part, once you have a chosen a way to decompress you must stick with that table or computer until you are "clear" of excess nitrogen.

KNOWING YOUR SUBJECTS

In this shot a basket sponge is releasing a cloud of reproductive cells into the water in the act of spawning. In order to capture images like this one, you have to know enough about marine life to recognize the behavior.

Text and photography by Marty Snyderman

A year or so ago I was in Grand Cayman leading a Nikonos Technique seminar through Sea & Sea Travel when I made a dive with about ten of my students. All were sport divers, hobbyists, not professional underwater photographers. During the seminars we don't normally dive together in large groups, but this particular dive we were all swimming together over to the edge of Cayman's famous North Wall before the various buddy teams went off to do their own things. As we were swimming toward the edge of the drop we traversed directly over a cleaning station where a dozen or so gobies and a Pederson's cleaning shrimp were at work on a large Nassau grouper. I pointed out the cleaning station to several divers and settled down to watch them go to work. I was fairly sure that with a group this large there would be considerable jockeying for the best position, and I was concerned that the bottom would get all stirred up or that the group would scare the groupers away. At least that was what I thought was going to happen.

Much to my amazement, the divers signaled back to me that they saw the groupers being cleaned, but they never even slowed down as they proceeded toward the drop-off. I was rather surprised by their response, but it was early in the week, and maybe I had a much more experienced group than I had realized.

Like many photographers I had shot cleaning stations on many previous occasions, but I just couldn't resist an opportunity like this. As I slowly crept in toward the now perfectly posed grouper, a terrible

From whales and sharks to angelfish and nudibranchs, few things are as important as knowing as much about your subject as you possibly can if unique images are what you have in mind.

thought went through my mind. *"If all those divers saw this cleaning station and passed it up, what in the world had they seen that I had not?"* I couldn't stand it. There was no way I could concentrate on what I was trying to do. Surely they were all hovering in the middle of a squadron of spotted eagle rays, or they were swimming with a pod of dolphins, or... *what could I possibly be missing?*

I was unable to control my curiosity, so I put my camera down by my side and hurried off into the blue to look for the magic opportunity. Enroute to catch the gang, I passed directly over a spawning basket sponge. No doubt about it, the milky white "smoke," actually sperm and eggs, was billowing out of the sponge in a

Top *Cannibalistic tuna crabs prey upon one of their own. Even when you enter the water with a photographic dive plan in mind, keep your eyes open for targets of opportunity, especially where behaviors are involved.*

Above *Scientists believe fish school for a variety of reasons- (1) to out reproduce what predators can consume, (2) to confuse predators, (3) to look larger than a single fish, and (4) so individuals can hide from potential predators by hiding in the group. Being aware of what animals are doing and why, can provide you with a lot of ideas for pictures you want to take.*

Left *The ribbon eel pictured here uses the lure-like appendages on its snout to attract potential prey. In order to get this shot, you need to know that ribbon eels exist and how they feed. The more you know about marine life, the more interesting your photography can be.*

thick white column. I was sure there was no way the gang could miss this. At that point I was really going crazy trying to swim even faster to get to the action, but when I caught up with the gang at the edge of the drop-off, everyone was calmly splitting off into pairs and descending over the edge. I looked quickly in every direction just hoping to catch a glimpse of whatever it was, but all I saw was blue water.

So I went back and filmed the spawning sponge and the activity at the cleaning station. But throughout the rest of my dive I couldn't help but feel little pangs of jealousy that I hadn't seen whatever it was that made everyone else swim past the cleaning station and the sponge.

As my dive ended I decided for the sake of my professional ego to play it cool on the boat. I'd just kind of hang around on the back deck and listen to everyone, and not bemoan the fact that I hadn't seen "the thing." However, when I got back to the boat, I was utterly amazed when most of the divers complained that this dive was the first dive of the trip during which they hadn't seen much. At first I thought they were putting me on. I wondered how they could possibly know I hadn't at least caught a glimpse of "the thing." However, after a few more minutes I became convinced that they were being sincere.

At that moment, I realized that I wanted to add a very important topic to my nightly presentations for the week. I wanted to talk about the importance of knowing your subject matter so you can take advantage of photo opportunities. As a group, these photographers probably took their underwater photography more seriously than most. And yet, most divers in this group had overlooked two terrific photo opportunities on their last dive. Like so many underwater photographers, these divers were so caught up in their equipment and how it works that they forgot the very essence of what they were trying to film. Marine wildlife. For most underwater photographers it is our fascination with wildlife that keeps us interested in our sport. Sure, some people are primarily interested in filming their friends underwater, but most of us pursue underwater photography because we want to take great pictures of marine plants and animals.

However, I think that far too many underwater photographers expect that the key to getting good photos of marine animals lies in their understanding of the technical characteristics of their equipment. They know all about the automatic exposure capablities of their cameras and strobes. Nice features no doubt. And they know all about what films the latest issue of some "in-the-know" photo magazine rated as the best for a particular application. Helpful stuff, I am sure. Their technical knowledge goes on and on, but they are overlooking one very important aspect of filming wildlife. And that is the importance of knowing as much about the natural history of your subject as possible.

A fundamental feature that separates the work of great underwater photographers from good underwater photographers is the photographer's knowledge about his or her subject, and their ability to create a unique image, based upon that knowledge. First you need to acquire the knowledge, and then you need the fortitude to put your knowledge to work.

Ever since I first saw Clay Wiseman's image of a bluethroat pikeblenny, I just had to take one of my own. Until I saw Clay's shot, I wasn't even familiar with the species. So I did a little reading and then I talked to Clay, who was very helpful and who readily gave me some insight into where to look for the species. I also read what Paul Humann had to say about the fish's preferred habitat in his book, **Reef Fish Identification: Florida, Caribbean, Bahamas**. Knowing that the best place to look for a bluethroat pikeblenny is in the northern Caribbean in less than ten feet of water in areas where sea grass dominates the bottom, that the species likes to inhabit the tubes of sand worms, and that they are often extremely territorial was of critical importance in my quest. I decided that I might be able to get a terrific shot of a male in a display of territoriality by taking a mirror which, if placed in the right position, might provoke a male bluethroat pikeblenny into a territorial display. A little research had provided me with the insight that a mirror would likely provide a better opportunity than would food, or night diving, or any other idea I could think of at the time.

I got my shot only a few minutes after I found the first pikeblenny I had ever seen. The main reason I experienced success is not that I am all that skilled in composing my images or in knowing any kind of technical secrets that other photographers are not aware of. No... the reason I got my shot was because I went to enough trouble to make a phone call, do a little reading, and buy a small mirror. And I made the commitment to myself that I was going to give my idea a solid chance to succeed. The result was a combination of knowledge and effort. It is a combination that often goes a long way in the field of wildlife photography.

The story of the bluethroat pikeblenny is only one of many similar incidents from my personal experiences. Getting a good shot of a male yellowhead jawfish, another Caribbean species, guarding his eggs in his mouth is another. I knew that yellowhead

jawfish inhabit sandy bottoms and rubble zones near coral reefs, but the photograph I really wanted was of a male guarding the fertilized eggs in his mouth. That's right. Yellowhead jawfish are mouth brooders. The male guards the fertilized eggs by holding them in his mouth until they hatch. Knowledge of the species was the key to getting this shot. I simply had to know about the behavior so I would know to look for an opportunity.

I got the shot at Grand Cayman. I remember exactly where I was. And I also remember that right next to the fish I filmed was another jawfish that was not holding any eggs in its mouth. If I had not done a little reading and seen a Cathy Church photograph, I simply wouldn't have known about the behavior or that the opportunity even existed.

My library is filled with images that followed a little bit of "research", at least a little light reading or a few minutes in front of a television. My photographs of California sea lions are another good example. Knowing that sea lion pups are generally far easier to approach in the late summer and fall can make all the difference in the world in terms of image quality when filming California sea lions off southern California or in Mexico. At other times of the year, either the mothers won't allow the pups to stray close to you, the pups are not interested in you, or the bulls won't allow you into the rookery area. In this case, knowing when to go for your photographs, in terms of the time of year, is of critical importance.

Often the difference in having a thorough base of knowledge about your subject allows you to take a picture that is something other than just a portrait. Knowledge gives you the ability to recognize certain behaviors or interrelationships that in turn can make your photographs standout. Recognizing a cleaning station can help you get very close to many species of fish such as groupers, coneys, and moray eels, etc. Knowing that damsel fish are highly territorial when nesting and knowing how to recognize a nest can help you get very close to garibaldi, sergeant majors, and other damsels. Of course, you have to know that these fish are members of the damsel fish family, and you have to do a bit of reading or research about these fish. But once you learn about the species, you will increase your odds of being able to get yourself in a favorable position to capture some unique images.

Another anecdote that quickly came to mind when I thought about this piece involved a boat skipper in Baja who was frustrated with his photographic results. The first several days I was on the boat he picked my brain about my photo gear. One afternoon as he was excitedly loading his camera, I asked him what he was up to. He told me he was going "to take a picture of one of those big gold bushes near the anchor." Gold bushes, what gold bushes I wondered? So naturally I followed him during the first few minutes of his dive.

The bushes were actually soft corals, which are animals not plants. The skipper kicked the coral while he was setting up his shot and almost all of the polyps which had been out feeding in the current, retracted instantly. I saw the pictures a few weeks later, and they were... well, boring. How could they possibly have been anything but boring? If you don't know your subject, how can you possibly depict its most interesting qualities?

In his case, I am really not sure that this person would have recognized a cleaning station if he had seen it, would know what a remora is, would recognize a fish's nest, would know that many jellyfish are accompanied by symbiotic fish, or would even recognize a clownfish in an anemone. How in the world could he possibly expect to take great photographs? Quality images require a lot more than technical expertise.

Sometimes we all film subjects that we don't really know much about, but the finest work from the best photographers is the result of doing a little homework before they go out and trip the shutter. To help your work attain that same level of viewer interest, learn about your subjects, don't just shoot them.

In researching this piece I referred to several photographic books and magazines in my library. I didn't find much help in photographic sources. At least I was trying to do a little research on the front end! Frankly, there isn't a lot that is written in photographic terms that can help with the subject. What I did read was that, "If you want to take great photographs of marine animals, it is very important that you know your subject well." So I found myself in a bit of a dilemma. I really want to be able to help you acquire images that you want to take, but I find myself constantly writing about my personal experiences. The reason is that the best way to get a shot of any given species is to know as much as you can about that particular animal. General thoughts such as taking bait, night diving, or trying for your shot during a particular time of year are always worth considering, but the most important thing you can do is to learn as much as you can about the creatures you want to film. To get truly spectacular photographs, you need to learn about each species, one at a time. I am simply relating some of my successes, just as they happened, one at a time. The important point is to realize just how valuable my research was to me, and how big a part of your success a little research can be.

So, how do you learn about the natural history of marine animals without going to graduate school and at the same time keep your learning process fun? Several ideas immediately come to mind. The first one is to read. While it might not have been true 15 or 20 years ago, today almost every place sport divers dive, someone has written a book for recreational enthusiasts about marine wildlife in the area. You do not have to read strict scientific texts that are

Many photographers want to film sea lions. To avoid a lot frustration, you need to know the best time of year to film sea lions - the late summer and fall - and the reasons why.

intended for graduate students who are doing work on their doctorate. Magazines like Sea Frontiers, Natural History, National Geographic, National Wildlife, and books such as the **Amber Forest**, **California Marine Life**, **Ocean Realm Guide to Reef Creatures** can be extremely helpful. Diving magazines such as ***Discover Diving*** and several others regularly print excellent pieces with an emphasis on natural history. Coffee table works such as Carl Roessler's **Coral Kingdoms**, and others such as **Ocean Life**, **The Living Oceans**, can be found in most book stores and places like the Scripp's Aquarium book store, the Monterey Bay Aquarium. Several works published by Facts on File, the Image Bank, and Publications International are also available.

One book that I found about a year ago that is a terrific resource is **Watching Fishes, Life and Behavior on Coral Reefs**. Written by Roberta and James Wilson, and published by Harper & Row, this text provides insight after insight into many of the behaviors and interrelationships in coral reef communities. I have recently been told that the book is no longer in print, but it is available at many libraries.

The point is, the information is readily available and it is written for laymen. These works are usually authored by people who are experts, but they are intended for a general audience.

Another excellent way to learn is to watch good television. The Public Broadcasting System (PBS), the Discovery Channel, the Arts & Entertainment Channel (A&E), Turner Network Television (TNT), and several others carry a wide variety of programs that deal with marine wildlife. I always find it interesting to learn when the film was produced so I can evaluate the information in it and the way marine life is dealt with. Not too long ago I saw the film, *Blue Water, White Death* on one of the networks. This film was made in the late 1960's and was about the first-ever expedition to film great white sharks and other open water sharks from outside of a shark cage.

If you saw that film today, you would probably think it was far too dramatic, perhaps corny, and certainly not the best shark film you had ever seen. However, as the first ever, it is a great film, and very educational.

Watching good films and reading can do wonders to help you improve your photography of marine wildlife. In all my years of being involved with underwater photography I have never seen a photographer who I thought was really good, or whose work was what I would call consistently interesting, who was not knowledgeable about his or her subjects. The insight provided by knowledge provides serious photographers with the ability to shoot unique images. So in the final analysis, my advice is for you to become a "student of your subjects," and watch your photography improve.

Residing in San Diego, author Marty Snyderman has been a contributing editor to ***Discover Diving*** *for three years. Marty also works as an assignment cinematographer, still photographer, author, and speaker who specializes in the marine environment. In addition, he works with* ***Sea & Sea Travel*** *in San Francisco as a Senior Field Associate, leading trips aboard a variety of liveaboard dive boats to exotic dive destinations around the world, including his participation leading photographic seminars for* ***Nikonos****, the underwater division of Nikon Inc.*

GILL NETS

A Tangled Controversy

Part II

"As we are now beginning to realize, the key to contemporary ecological consciousness is to see the diminishment of man and the diminishment of the planet and its nonhuman inhabitants as essentially one and the same problem."

George Sessions

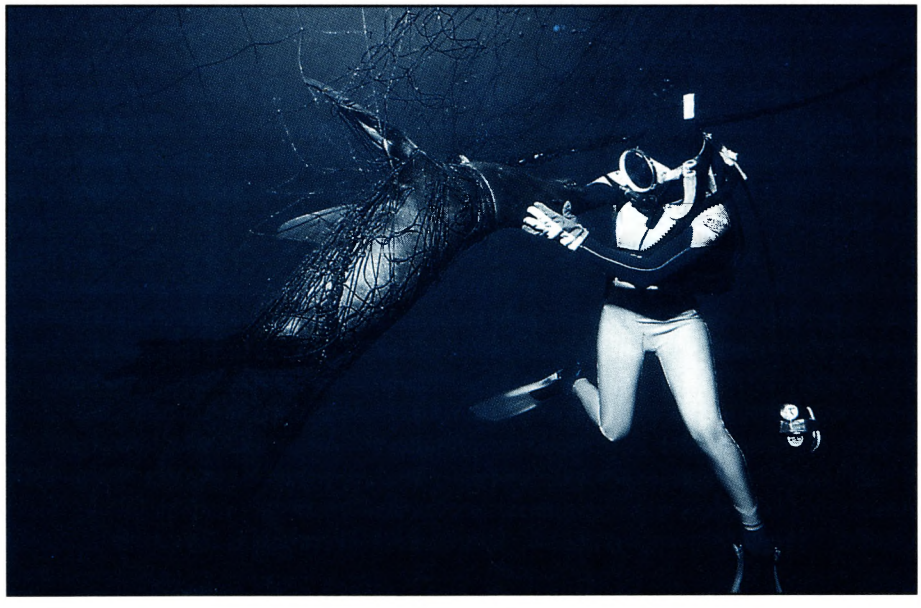
"Whatever befalls the earth befalls the sons of the earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself."

Chief Seattle

by Robert von Maier

In part I of this series, which appeared in the Sept/Oct issue of Discover Diving, I addressed several of the basic questions surrounding the gill net controversy. In this, the second and final part of the series, I will examine several important questions that pertain to some of the peripheral issues attached to this heated and tangled controversy.

As was the case with Part I, this work is not to be viewed as an exhaustive, complete study on entangling net fisheries or any of the various related issues involved. The author's sole intention is to provide the reader with a basic knowledge of a subject that has historically been surrounded by a plethora of misinformation.



WHAT ARE "GHOST NETS"?

Pelagic drift nets that are lost or discarded are referred to as "ghost nets". The name stems from the fact that the nets continue to entangle marine animals long after they have been lost or discarded.

Each night, several thousand miles of the monofilament nets are set in pelagic waters. The majority of the high seas drift nets are from Japanese vessels. However, Taiwan and South Korea are also responsible for a large number of sets. It is estimated that more than 25,000 miles of nets are set every night.

In addition to the fact that drift nets indiscriminately kill huge numbers of marine mammals, seabirds, fish and other marine animals, the loss and discard of the nets has tremendous adverse consequences both environmentally and socio-economically. Due to the construction of the nets (they are made of non-biodegradeable monofilament/multifilament mesh that is nearly indestructible) the "ghost nets" continue to "fish" as they drift unseen and untended. The nets that do not wash ashore will eventually sink due to the weight of

barnacles, seaweed, and dead animals that have become ensnared. Once the nets have settled to the bottom they continue to entangle bottom-dwelling fish and a variety of invertebrates. Many of the "ghost nets" are caught in the propellers and shafts of fishing and other vessels causing economic loss as well as endangering human lives.

It is impossible to know exactly how much of the netting is lost or discarded and ultimately becomes "ghost nets". However, conservative estimates show that the Japanese squid and salmon driftnet fisheries account for nearly 2000 miles of lost and/or discarded netting per season. This does not take into account other Japanese driftnet fisheries or additional driftnet fisheries from other countries.

Due to the enormous adverse affects of high seas driftnetting the United Nations General Assembly recently passed a resolution which calls for an international ban on pelagic large-scale drift gill nets. The ban is to go into effect by June 30, 1992. Unfortunately, Taiwan and South Korea (both large-scale contributors to the pelagic driftnet fisheries) are not UN members and are not likely candidates to support or abide by the resolution.

ASIDE FROM NON-TARGET, NON-COMMERCIAL ANIMALS THAT ARE TRAPPED IN THE GILL NETS AND QUITE OFTEN BECOME "INCIDENTAL KILLS", ARE 100% OF THE TARGET SPECIES SUCCESSFULLY NETTED AND LANDED ?

The answer is a resounding no. In fact, some research that has been conducted in this area shows that in many cases over 50% of the target species, once trapped in the nets, are lost to predators and/or scavengers such as sharks, seals, sea lions, crabs and other various marine animals.

Most near-shore gill nets are set for one or two night at a time. As would be suspected, the nets that were out for two nights showed a higher loss of target species than those nets set for just one night. Occasionally, a fisherman will set his nets with the intention of leaving it out for one night only. However, due to inclement weather he may not be able to retrieve them for two or more nights thereafter. This unfortunately leads not only to more non-target species being trapped, but causes a greater loss of the target species as well.

WHAT IS PROPOSITION 132, THE MARINE RESOURCES PROTECTION ACT OF 1990?

Southern California is presently one of the last coastal areas along the western United States where gill nets are still legal. In the 1980's, large-scale gill net bans were enacted in Central and Northern California up through Canada. Even Japan, the largest single drift gillnetting operation in the world, does not allow near-shore gill nets.

If passed by the voters in November, 1990, Proposition 132, The Marine Resources Protection Act of 1990 would:

- Establish a Marine Resources Protection Zone extending three miles off the Southern California coast from Point Conception to the Mexican border - and outlaw the use of gill and trammel nets in this area.
- Make permanent California's current ban on gill nets along the Central and Northern California coast.

- Require additional permits for use of gill and trammel nets in the Marine Resources Protection Zone from January 1, 1991, to December 31, 1994, until the outright gill net ban became effective on January 1, 1994.
- Compensate commercial fishermen for the loss of their gill net permits after January 1, 1994 - the funds coming from the creation of a $3 Marine Protection Stamp required for sportfishing in the Marine Resources Protection Zone through January 1, 1995.
- Require the California Department of Fish and Game to establish four new "ocean water" ecological reserves for marine research.
- Require the California Department of Fish and Game to monitor and evaluate the daily catch of commercial fishermen.

IF PROPOSITION 132, THE MARINE RESOURCES PROTECTION ACT OF 1990 IS APPROVED BY THE VOTERS, WHAT ALTERNATIVES TO GILLNETTING WILL COMMERCIAL FISHERMEN HAVE ?

Considering the fact that there are less than 300 active gill net fishermen in the Southern California area, the problem of alternatives does not present a major dilemma. In fact, the banning of gill nets does not have to put anyone out of work.

The majority of the fishermen involved do not depend on gillnetting for a living. Most of them are involved in gillnetting on a limited part-time basis and hold permits for a variety of other commercial fisheries. A select few are involved in gillnetting to facilitate writing off the expenses of their boat.

If Proposition 132 is passed, the fishermen have the option of fishing outside the conservation zone or with other types of fishing gear such as hook and line which has proven to be a very effective technique for halibut in Northern California as well as halibut off Canada and Alaska. (Halibut presently accounts for up to 60% of the near-shore gill net catch.)

As stated above, if The Marine Resources Protection Act of 1990 passes gillnetters will be financially compensated for the loss of their gear. The funds for this compensation will come from the creation of a $3 Marine Protection Stamp that will be required for sportfishing in the Marine Resources Protection Zone through January 1, 1995.

There are certainly many additional questions that have yet to be answered concerning entangling net fisheries and the peripheral issues surrounding their use. Readers who wish to inquire further on this issue or who simply desire to comment on this series are encouraged to contact the author through Watersport Publishing, Gill Net Controversy, P.O. Box 83727, San Diego, CA 92138.

...about Dive Tables

by Eric Hanauer

Diving used to be simple. We followed the U.S. Navy Tables, remained within no-decompression limits, and felt safe from the bends. If anything happened, it was usually our own fault. Then dive computers came along, with multi-level adaptations of the tables. Suddenly, we were pushing the limits of the envelope, diving profiles that would have been impossible before. And a few of us were getting bent.

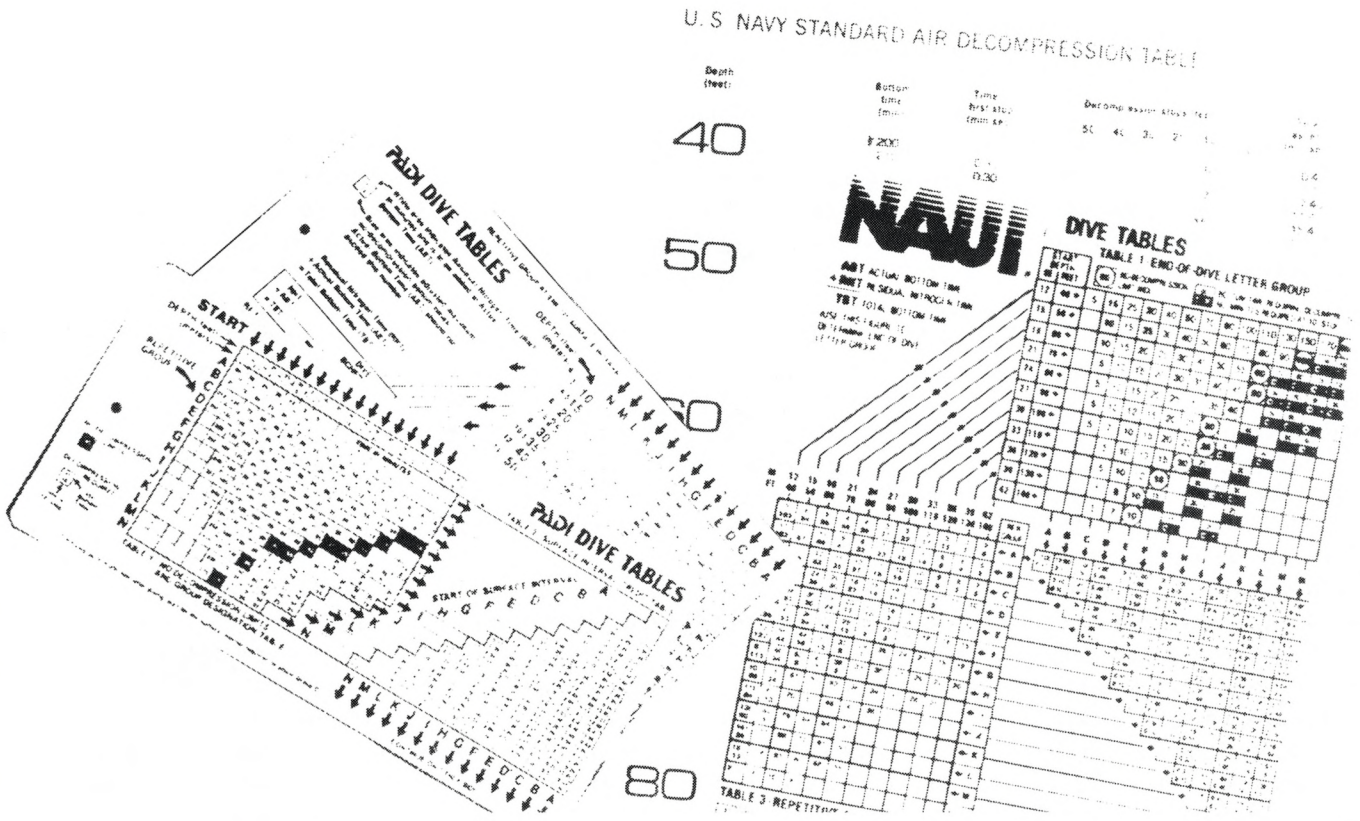
All versions of the dive tables, as well as all computer algorithms in use today, are based on research done by John Scott Haldane in 1910. That was 80 years ago, and lots of bubbles have been blown since then. Haldane's research was based on dissolved gas theory. Remember when your basic scuba instructor used the Coke bottle analogy, about gas coming out of solution and fizzing when the cap was removed? After a few reckless dives early in my career, I spent some sleepless nights imagining those fizzies in my bloodstream.

Now a group of scientists is telling us that Haldane didn't have all the answers. Their studies on origination and growth of bubbles will form the basis for a new set of diving tables. The problem they are addressing is there are gaps in our tables that aren't explained by Haldanean theory. Saturation diving at one extreme, and bounce diving at the other, fit neatly (but not simultaneously) into Haldane's model. This is because those dive profiles are fitted to dissolved gas models. Unfortunately, the sort of activity done by sport divers — multi-level, multi-day, repetitive diving — isn't. This is where sport divers have been bent using the tables and computers. This is why cautious divers have developed "fudge factors", like abbreviated bottom times and safety decompression stops, to make computers safer. You see, the Navy tables were based and tested on the principle of one dive a day, at one level, with perhaps one repetitive dive later. That's the sort of diving Navy divers do. Everything else was extrapolated from that original table. Usually it works, but sometimes it doesn't. And it takes only one mistake to result in paralysis.

"Now a group of scientists is telling us that Haldane didn't have all the answers... The problem they are addressing is there are gaps in our tables that aren't explained by Haldanean theory..."

The bubble mechanics theorists believe that their approach, encompassing both free and dissolved phases, will result in a table which safely covers the entire spectrum of diving. And it will do the job without the use of fudge factors, except for extenuating circumstances like cold, excessive work load, or poor physical condition. It is based on research done by David Yount and Richard Strauss in 1975, and additional work by Chris Lambertsen, Tom Kunkle, Brian Hills, and Val Hempleman. Essentially, bubble mechanics theory, or free phase dynamics, is based on the concept that micronuclei, or "bubble seeds", are always present in our body. Under certain conditions, these will grow into bubbles that will cause bends.

One of the more articulate spokesmen for free phase dynamics is Dr. Bruce Wienke, a physicist at Los Alamos National Laboratory. Wienke's degrees are in nuclear physics and particle physics; the major portion of his work is secret Department of Energy stuff. He first became interested in bubble mechanics to address problems in the cooling systems of nuclear reactors. There, bubbles forming in liquid sodium could interrupt flow patterns in pipes, similar to what happens to blood in our capillaries during bends. When he became a diver, Wienke continued to pursue the question as it applied to underwater activity. Today, Bruce is an Instructor Trainer with NAUI, a Master Instructor



with PADI, and an Institute Director with the YMCA scuba program. Serving on advisory boards for all three organizations, he pursues this activity with the same intensity as he does his other avocation, ski racing. So when an opportunity arose to interview Wienke about bubble mechanics, I jumped at it.

To comprehend bubble mechanics, we must first examine Haldane's dissolved gas theory. Haldane, a British physiologist, saturated goats in a chamber to depths of 165 feet, and observed that they didn't suffer bends if decompression was limited to half the ambient pressure. Since tissues apparently tolerate twice the pressure without symptoms, he designed schedules limiting the critical saturation ratio to two in hypothetical tissue compartments. A "compartment" is merely a mathematical model, and does not directly correspond to any specific tissue in our bodies. Each compartment was categorized by its half-life, the time required for it to lose half (or gain double) its nitrogen. Fast compartments control deep, short dives while slower tissues control shallower, longer exposures. Originally, there were five compartments: 5, 10, 20, 40, and 75 minutes. Each had its own critical pressure (M-value), the maximum limit of dissolved gas. In the U.S. Navy Tables, 80 replaced the 75 minute tissue, and a 120 minute compartment was added to accommodate deeper dives. Today's computers utilize compartments up to 720 minutes. This proliferation of compartments is a clue that we don't fully understand what is going on.

Over years of use, gaps appeared in the tables that weren't explained by dissolved gas theory. On certain exposures, there were greater incidences of bends. The tables would then be revised to cover those circumstances, even when that revision didn't agree with Haldane's original calculations. Wienke and his cohorts aren't comfortable with this patchwork approach. Their goal was to develop an algorithm (mathematical model) that was consistent with theory all across the diving spectrum, including bounce, multi-level, repetitive, and multi-day diving. This model is intended to predict safe diving protocols for all depths and all sorts of diving, without having to resort to quick fixes and fudge factors. It will be a model you can trust your body to.

Bubble mechanics theory begins with the concept that our tissues store persistent gas micronuclei. These have been demonstrated experimentally in gels, agar, salmon, and shrimp. Micronuclei are bubble seeds, about a micron in diameter. For comparison, red blood cells measure three microns, and a Doppler meter cannot detect "silent bubbles" (non-symptomatic bubbles) less that 20 to 30 microns across. How did these micronuclei get there? The process is not entirely understood. Possible causes include gas in intestines or in fluids we drink, gas from the air-lung interface, exercise, and the mechanics of blood coursing through our vessels, among others. Even cosmic radiation and charged particles are suspected causes.

Micronuclei are stable at fixed pressure, but can become unstable when exposed to pressure changes. They are classified in families, according to their size and the characteristics of their surface-activated molecules (surfactants). Larger

families are more excitable, that is, they develop and grow into bubbles more readily.

As pressure decreases on ascent, the micronuclei are surrounded by dissolved gases at high tension (pressure). When tissues around a bubble site are at a higher pressure than the bubble, gases diffuse from the tissue into the bubble. This increases internal pressure, making it unstable, and causing it to grow. The rate at which bubbles grow depends directly on the difference between tissue tension and ambient pressure. At some point, a critical volume of bubbles is established, and symptoms of bends can begin. This point can be calculated and correlated with data.

During compression (descent) on the other hand, the micronuclei are crunched down to smaller sizes, apparently stabilizing at the new reduced size. This is one of the fundamental differences between free phase and dissolved phase dynamics: the gradients for free phase elimination increase with depth, directly opposite to dissolved phase gradients which decrease with depth. Essentially, Haldanean procedures "treat" bubbles, while free phase dynamics "minimize" bubbles.

This leads to one of Wienke's more interesting recommendations: make the first dive of a multi-day series a deep one. He explains that this procedure effectively shrinks and stabilizes micronuclei, allowing the diver to remain relatively clean for longer periods of time. This is tempered with the warning that all subsequent dives should be shallower, thus working within the crush limits of the first dive, and minimizing excitation of smaller micronuclei. Frequent dives, at least every other day, deplete the number of micronuclei available to form potential bubbles. It takes about a week for some classes of micronuclei to regenerate. This is one way the body adapts to repetitive diving.

A word of caution is in order at this point. Short, deep dives will crush micronuclei, but longer exposures, or cumulative deep exposures will saturate the system with growing bubbles, exceeding the body's ability to eliminate them. How long is too long? A table based on free phase dynamics would provide the answer.

Wienke cites two groups of divers, who never heard of free-phase dynamics or the research behind it, but have developed amazing procedures that fit this theory. In northern Australia, Okinawan pearl divers regularly dive to depths of 300 feet for up to an hour, twice a day, six days a week, ten months out of the year. Their decompression schedules, developed through economic necessity rather than science, involve deeper but shorter stops than required by Haldane theory. These are entirely consistent with minimizing bubble growth and the excitation of nuclei through the application of increased pressure.

As expected, anything so radical does result in a number of cases of bends. Consequently, the Australians have developed simple, but effective in-water decompression procedures. The stricken diver is taken back down to 30 feet on oxygen for about 30 minutes in mild cases, or 60 minutes in severe cases. Increased pressures help to shrink bubbles, while pure oxygen enhances dissolved gas elimination. These time scales are far too short for Haldanean decompression, but are consistent with bubble research.

Hawaiian net fishermen use similar procedures, making 8 to 12 dives a day to depths beyond 350 feet. Although they too know nothing of bubble models or nucleation theory, their protocols are consistent with them. The deepest dive is made first, followed by shallower excursions. A typical series might start with a dive to 220 feet, followed by two dives to 120 feet, and finish with 3 or 4 dives less than 60 feet. Little or no surface intervals are clocked between dives.

These procedures virtually rape the Haldanean tables, but make sense when viewed in the light of bubble mechanics. Ascending profiles (deepest dive first, followed by shallower ones) and deeper decompression stops keep micronuclei excitation and bubble growth within the body's capacity to eliminate both inert gas phases. The final shallow dives can be viewed as prolonged safety stops. In-water recompression procedures are similar to those of the Australians.

Obviously, no sport diver should attempt these profiles. The risk of bends, while less than expected, is still far too high to be acceptable. Additionally, the extreme depths mentioned above would result in oxygen toxicity for most divers.

Many scientists scoff at these seat-of-the-pants decompression methods. But the Hawaiian procedures have been duplicated experimentally in animals by Tom Kunkle and Ed Beckman.

At Catalina Island, Andy Pilmanis took people on bounce dives to 100 feet. Some came up directly, others made safety stops in the 10 to 20 foot range. Venous bubbles were 4 to 5 times less in the group making the safety stops. From this and other related research has come the current AAUS (American Academy of Underwater Sciences) recommendation of a 5 minute safety stop between 15 and 25 feet after any dive near the limits of the tables.

Wienke is presently working on a new diving algorithm based on bubble mechan-

ics theory. It will track both free phase (bubble theory) and dissolved phase (Haldanean theory) dynamics. He is encouraged so far, reporting that when certain parameters are tweaked, things go the right way. That's not always the case with Haldane's model. Testing and implementation are still required, but when it's released, Wienke should have something that will change the way we dive, just as the first dive computers did.

I asked Bruce to discuss some features of the new algorithm, and how it will differ from present models. Here are some of them.

Safety stops will be an essential component, because if you catch the bubbles while they are small enough, they are easier to stabilize. These stops would be at around 15 to 25 feet, about the same as AAUS recommendations. The higher ambient pressure (than the usual 10-foot stop) crunches down bubbles, allowing them to pass through the pulmonary filter system, to break up, or to dissolve. The smaller the bubble, the easier it is to eliminate. Dissolved gas buildup in slow tissues during a safety stop is negligible, compared to benefit of the reduction in bubble growth.

Deep repetitive dives with short surface intervals will be restricted. Deeper exposures on subsequent dives would carry a far greater time penalty than present models. The reason is that these dives excite additional, smaller classes of micronuclei after larger classes have already been excited on the previous dive. The result is a greater risk of bends. Because the body's ability to eliminate free gas phases decreases with time at pressure, no-decompression limits will be shorter than the Navy Tables. Surface intervals will be longer than present computer algorithms. The 60 foot per minute ascent rate will probably be retained, because most divers haven't mastered that, much less the slower rates of most present-day computers. Safety stops effectively take care of slowing down ascent rates, and they are more efficient.

But the primary difference from a scientist's standpoint is that decompression procedures will flow naturally from this model; it will be a more realistic and more accurate predictor, without the jerry-rigging and quick fixes required to keep the Haldanean model going.

Until the new model is ready, we are stuck with our present tables and computers. In the interim, Wienke recommends some procedures we can follow right now to make our diving safer. These have come out of recent workshops and technical forums:

1. Make no more than three repetitive, deep dives per day.

2. Avoid multi-day, multi-level, or repetitive dives to increasing depths. Make the deepest dive first.

3. Wait 12 hours before flying after regular diving, 24 hours after heavy diving (hard work, near decompression, or prolonged repetitive activity).

4. Avoid multiple surface ascents and short repetitive dives (spike diving) within surface intervals of one hour.

5. Surface intervals of over an hour are recommended for repetitive diving.

6. Safety stops for 2 to 4 minutes in the 15 to 25 foot zone are advisable for all diving, but especially for deep, repetitive, and multi-day exposures.

7. Do not dive at altitudes above 10,000 feet using conventional tables with altitude modifications.

8. Dive conservatively. Tables and meters are not bends-proof.

Significant changes are coming in the way we dive into the '90s. There will be more in future issues as this story develops. Stay tuned.

This article also appeared in Scubapro Diving & Snorkeling, Fall 1990. The information is important enough that it is reprinted here with permission.

BENT/Mark Weinhold

When mollusks scare themselves

Taking the Last Breath

by Craig Webber

I've been safely diving above Fort Ross on the northern California coast for many years, but one Sunday morning during late September of 1989 I allowed my years of confidence and training to replace my safe diving practices; I almost drowned. One rule which is, in many instances, important in diving is to "never dive without a buddy." My buddy George and I have always been safe divers. We inspect each other's equipment and assist each other while getting into and out of the ocean. But we had always made one exception in our safe diving practices; we separated our buddy team while spearfishing. After my diving accident that Sunday, we both learned that all of our technical abilities and our feelings of security while diving can easily be swept aside by the ocean's power.

That morning George and I pulled ourselves into our wetsuits and began putting on the rest of our equipment. We helped each other slide into our bouyancy control devices holding our eighty cubic-foot tanks, strapped on our weight belts, picked up our fins, masks, spearguns and labored under the weight of our gear while we half-slid and half-walked down a sandy path. The path led down to a beach where black, beige and gray marble-size stones substituted for sand below the wind-blown and water-worn sandstone cliffs. The tide was very low and the rocky bottom of the small cove was exposed to the morning overcast and wind.

Upon reaching the beach, we put on the rest our equipment, turned on our air, and stumbled over the exposed rocks while trying to reach the water's edge. We began surface-swimming toward a large, pointed wash-rock that was the reference point from which we had started many other dives. The low tidal conditions and the morning's strong offshore winds tossed us back and forth on the surface. After reaching the leeward side of the wash-rock, protected from the wind, George and I again check each others equipment, making sure it was all working and properly secured for our descent.

We began our descent through the greenish water. The ten foot visibility was average for the north coast, although on some days you can't see what you're holding in your hand at arm's length. We drifted down and watched the bottom of the wash-rock appear through September's cold and cloudy water. Reaching the bottom, we again checked our equipment, making sure it remained secure and working.

Then George and I looked around and kicked off in different directions as we've always done while spearfishing. George kicked off in a westerly direction toward deeper water and I stayed at 40 feet while swimming off to the south. Kicking away from the protected side of the wash-rock is when I first felt the surging water near the bottom. It rolled and pushed me back and forth like a goldfish being shaken in its bowl. At 40 feet, exhaled air bubbles rang past my ears, cold water numbed my face, and my deep rhythmic breathing combined with the constant rocking of the surge lulling me into a euphoria of security. The ocean was enchantingly beautiful, and I swam along and scanned the ocean bottom, turning my head from side to side, always surprised and never tiring of the variety and abundance of life in these colder northern waters.

The bottom and the sides of rocks were covered with foot long, flowing sea fans that swayed back and forth. The bottom was covered with piles of boulders

To my surprise I was instantly sucked down inside a large cave!

with dozens of abalone jamming every crevice. But I was spearfishing for lingcod, a large green-skinned elongated fish with a hideous face and mouth full of razor-sharp, canine-like teeth. They lie under rock ledges for protection from harbor seals and sea lions and use their stealthy hiding places to lunge at smaller fishes.

After shooting a three foot green ling cod, I continued searching among the rocks and found no other fish, so I decided to kick closer to shore to study the rock formations while looking for more fish. As I made my way along the shoreline at a depth of 20 feet, a large rock formation caught my

attention from the corner of my left eye. I was attracted to this rectangular architecture of large boulders and swam near what appeared to be an entrance into the formation. To my surprise I was instantly sucked down inside a large cave!

The cave was a round chamber. It was like being inside a large ball with two openings at opposite ends, halfway up the sides of the walls, allowing long ribbons of dappled light to stream into the chamber. The surging, turbulent water began thrashing me, slamming me against the top and the sides of the chamber. I finally grabbed the edge of a rock and pulled myself upright while bracing myself against the surging waters. Reaching down, I pulled up my gauges and in the cool grey light of the chamber I was astonished to see that my air supply was dangerously low—down to 500 pounds. I was breathing hard, using a lot of air while fighting the turbulent waters and I knew I must surface within minutes. I swam toward the opening where I had been drawn down into the chamber. As I swam to within an arm's length of the exit, the surging water pulled me back into the cave. I flipped around and swam toward the other opening on the opposite side of the chamber. I reached out and nearly grabbed the mouth of the second exit as the surging water again pulled me back into the middle. I was caught between the flowing of these two surges pulling me back into the center from both directions. I needed to act quickly — my air was running out.

George flashed into my mind. Why had we separated? Every good diver knows that you don't separate from your buddy. If George was here I would have his hand, a speargun to pull on, or even a piece of kelp that he could cut with his knife and I could use as a rope. A wave of fear shuddered through my already chilled and fast tiring body. If I got out of this, I wasn't going to separate from George or any other diving partner again. But George wasn't here, it was only me. My breathing was becoming labored. Air wasn't available on demand anymore and I had to draw hard on my first stage to bring air into my lungs.

I looked around and all I saw was the rocks. Then it occurred to me that if I was rock climbing I would have to pull myself up the face of any cliff I climbed to resist the pulling of gravity. I furiously kicked toward the first exit and again the surging waters pulled me back into the chamber. I gripped the rocks against the powerfully flowing current and waited for it to stop pulling me back. Again the surging water reversed and pushed me toward the exit. I swam as fast as I could on this outward jet of current, but the water again reversed its flow and tried pulling me back into the center as I gripped the rocks closer to the chamber's exit, holding on to the precious few feet I'd gained against the tearing force of the water. The surging water reversed again, and this final bursting jet of water ejected me through the opening — I was finally free. My air was almost gone and I sucked on my regulator, drawing the final breath from my tank as I frantically kicked upward and burst through the surface.

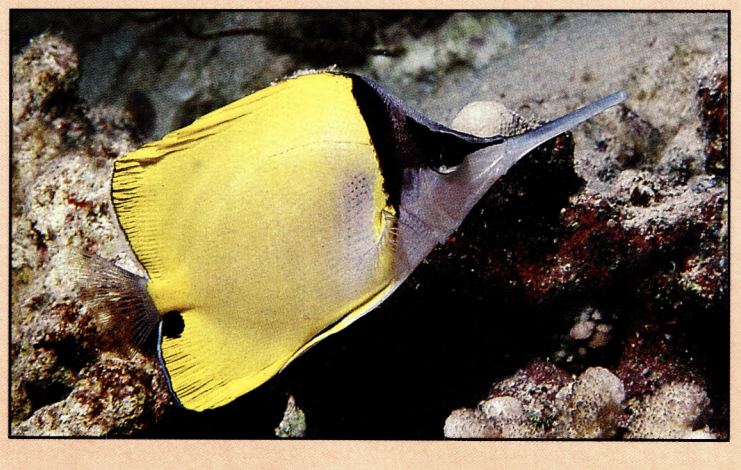
I was breathing hard, using a lot of air while fighting the turbulent waters and I knew I must surface within minutes.

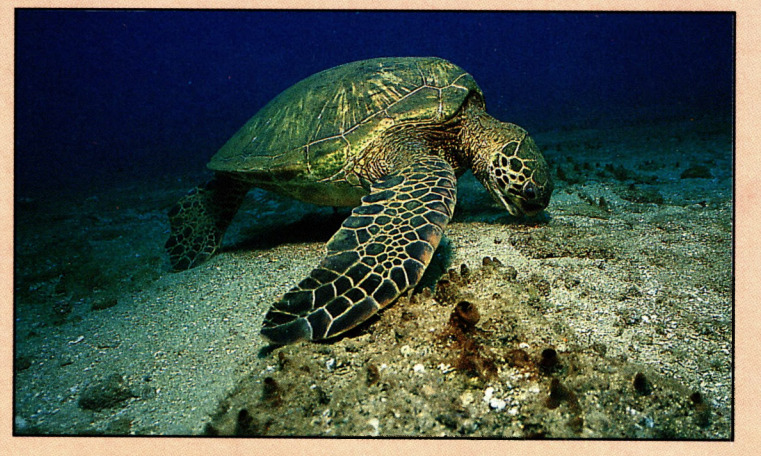
On the surface, gasping for air, I tried to inflate my vest with air from my power inflator, but there was no air left. I took a deep breath and blew air into the vest as I began swimming toward shore through the rumbling and choppy swells. I pulled myself over and through a thick layer of kelp just outside the surf zone. Immediately after entering the surf a large wave picked me up and rolled me out of the ocean onto a large flat rock that substituted for a beach in this rocky cove. I crawled on my hands and knees up this flat, sloping layer of sandstone leading up the cliff.

I was both physically and emotionally exhausted as I pulled myself up the cliff's narrow zig-zagging path while dragging my gear and fish behind me. I knew what it meant to be alone. Not the peaceful feelings of quiet and isolation I'd experienced in the beginning of my dive, but this was an emptiness, an absence of feeling, a void which began filling with doubt and fear. I realized that I was only an uninvited visitor in a beautiful, yet alien and sometimes treacherous environment. I had to rely upon the collective efforts of people in the buddy teams I dived with rather than just my specific wishes of how I planned to spearfish. From now on, now that I had a second chance, staying together would be an absolute while diving because I didn't know if I would ever again receive another generous warning about the importance of diving safely.

A Kaua'i Sampler

As our helicopter lifted from the tarmac, music filled the gaps between our pilot's narration about the history and the points of interest passing beneath us. We flew over ancient construction sites, then vast fields of sugar cane, on our way to one of the geologic wonders of the state. The helicopter seemed to labor as we approached the lip of a ridge, then easily swept into the chasm of the Waimea Canyon. It was a tear between trying to take in the entire vista that just unfolded before us, and regrouping our hearts that were left somewhere back on the ridge. The panoramic expanse was only an introduction to what was ahead of us. Approaching the coastline, we looked down to see the wide sandy beaches of Barking Sands, then into the distance at the "Forbidden Isle" of Ni'ihau. Showing a skilled hand at maneuvering in tight spaces, our pilot brought the craft to within a few feet of water cascading hundreds of feet from the streams above. The NaPali coastline captivated our view, as we continued north, its verdant cliffs stacked one against the other in a spectacular display of nature's handiwork. Hanalei Bay (home of "Puff, The Magic Dragon") was next on the flight, and the beginning leg of our return. One last thrill was flying into an overcast, mountainous region, that opened to a wall of 14 different waterfalls, canopied by the low hanging clouds that nourish the wettest spot on earth - Mt. Wai'ale'ale. This 50



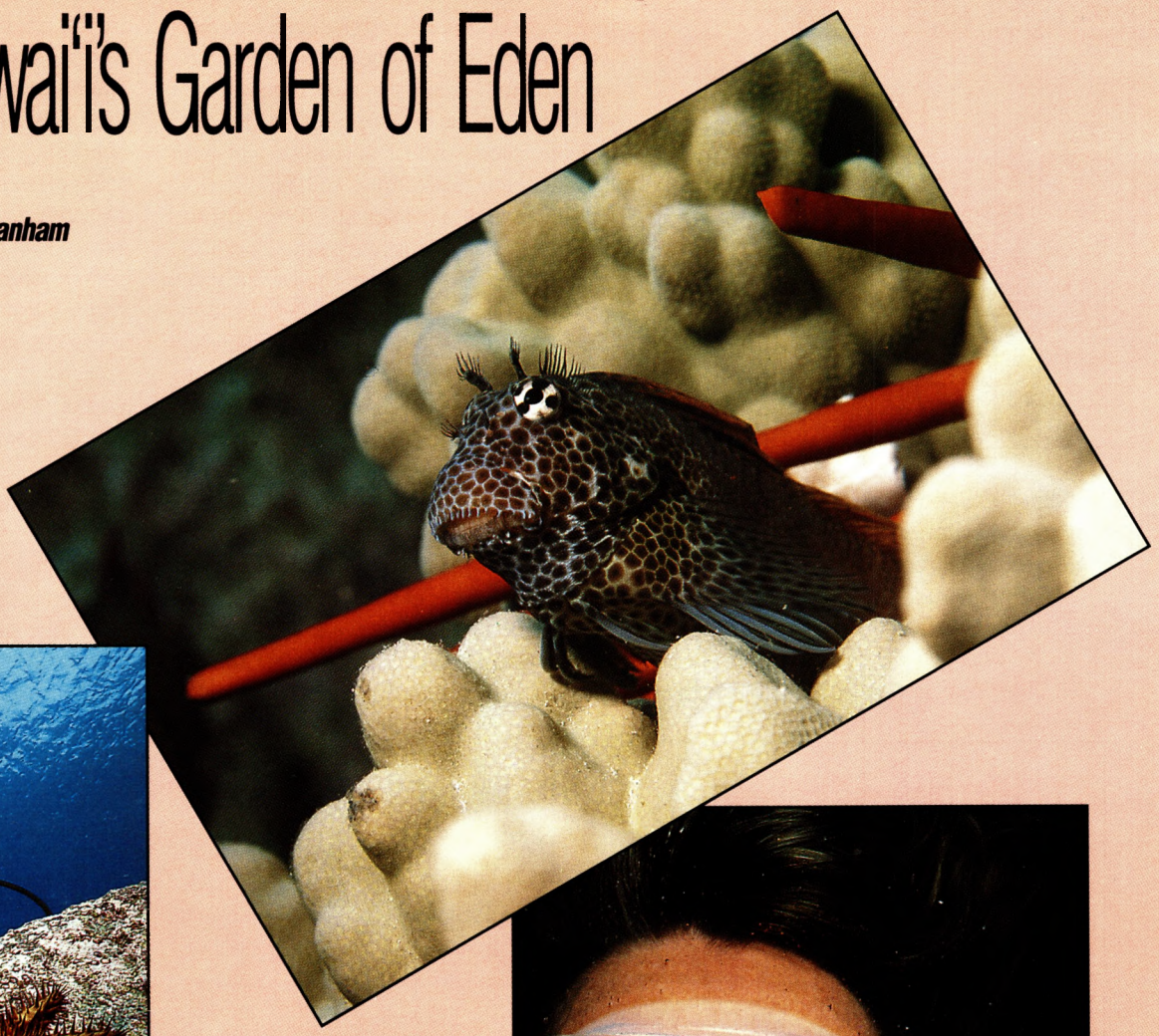


Top *The common longnose butterflyfish has the longest Hawaiian name - Lau wiliwili nukunuku 'oi 'oi.*

Above *The green sea turtle can be observed and photographed closely when approached in a nonthreatening manner.*

Beneath Hawai'i's Garden of Eden

Text and photography by Rod Canham



Above Right *A shortbodied blenny waits atop a coral head for passing prey.*

Above *A crown-of-thorns sea star is as menacing as it looks, with venomous spines on its topside.*

Right *The venomous spines of the colorful Hawaiian turkeyfish provide protection from unwary predators and handlers.*

Overview: Kaua'i

Nickname	The "Garden Isle"
Area	553.3 square miles
Coastline	90 miles
Highest peak	Kawaikini - 5,243 feet
Population	48,400 (12/31/89 estimate)
County seat	Lihu'e
Airport	Lihu'e
Distance to Honolulu	102 miles
Agriculture	sugar, taro

minute "E-ticket" special opened views to us made naturally inaccessible by the inhospitable topography, and served as our bird's-eye introduction to one of the most beautiful islands in the world.

Nowhere in the Hawaiian Islands is the allure, romance and embodiment of the Polynesian South Pacific more exemplified than on Kaua'i. This small emerald green island is the northernmost and oldest of the main Hawaiian Islands. Eons of time and erosion have sculptured it into an eclectic blend of flat agricultural plains, mountainous backdrops, and feral rocky coastlines that are interrupted by pristine sandy beaches. Blanketed by thick tropical foliage, the "Garden Isle" has awed visitors with natural wonders and inspired painters, writers, photo and cinematographers. Man has done little to mar the Eden-like beauty of Kaua'i, leaving the island free of towering commercial and resort edifices.

Kaua'i's topographical formations are as weathered and splendid underwater as they are above. Most of critter life here is the same throughout the islands, but Kaua'i fringes the remote northwest, and is influenced by marine life unique to that area. If you get thrilled by seeing rare and unusual fish, towering underwater formations, and can handle conditions that are sometimes less than perfect, this is the island to explore.

The heavy swells generated from winter storms far out to sea, and strong trade winds usually dictate what dive sites around the island are accessible. When the conditions are ideal, majestic and wild areas are open that are often too hostile to attempt, but the mainstay of diving Kaua'i is the **South Shore** - protected from the winter swells and northeast trade winds, and thus, diveable year round. There is rarely a strong current, and most sites are within a 15 minute boat ride from the launch at Kuku'iula Harbor.

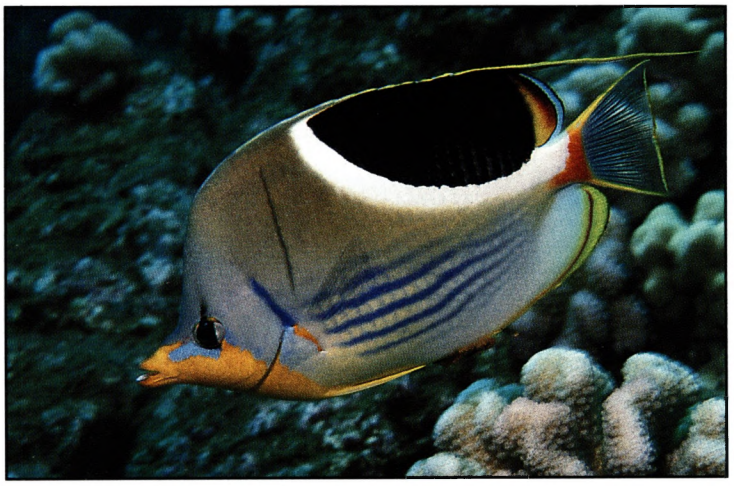
Sheraton Caverns, located directly off the Sheraton Kaua'i, is probably the most requested dive site on the south coast. Three main chambers, laid out in a "Y" configuration, could fit about four divers swimming abreast, with plenty of light being offered through several openings in the ceiling. The base of the "Y" has a lobster rookery, and the western chamber has schools of 20 to 30 surgeon fish, while *ta'ape* cluster in and about the cave structures. The site is known as having "tame everything." Whitemouth moray eels named "Gramps", "Brutus", and "Little Ceasar" compete for attention with juvenile conger eels, and a pair of whitemouths named "Little Squirt" and "Skitzo". The stars of the site are two small turtles named "Pepe" and "LePue". Always ready for the midday charters, they greet everyone by the swim steps, swimming side by side with the snorkelers, and escorting the divers.

One of the most important harbors in 19th century Hawai'i is now the most popular shoredive site along the south coast, **Koloa Landing**. Anchors and chains, remnants of yesteryear's commercial traffic, are strewn about an open sandy area. A horseshoe shaped reef, with an abundance of coral growth, is the gathering place for schooling *ta'ape*, moorish idols, *'u'u's*, parrot fish, and the rare saddleback butterflyfish. Hawaiian lobster and dragon moray eels have also been observed here. Koloa Landing can be done as two separate dives, heading east along one reef, then west along the other. The top is in 10 to 15 feet, and is ideal for intro's, snorkelers, and divers that like lots of light, bottom time, and night diving. **Caution:** Breakers and westerly currents sometimes sweep the area and divers should use caution.

West of Koloa Landing is a large, sandy plateau interrupted by a lone pyramid shaped pinnacle that rises from the 35 foot bottom to within three feet of the surface. It stands as a beacon to triggerfish, porcupinefish, pennantfish and butterflyfish, with much the same magnetism as an **Oasis** (Pinnacle Reef) in a sandy desert. Ledges surround the pinnacle like the brim of a hat, and are loaded with lobster, moray eels, and turtles. The flats are home to

octopus, and serve as patrol grounds for timid eagle rays. A V-shaped aberration in the top of the pinnacle is possibly the scar from an encounter with a 19th century steamer, *Pele*.

The ill-fated ship limped slightly to the southwest, and sunk on a sight now known as **General Store**. Its remains have been spread about with three of its five anchors close to the lip of one lava tube, and the other two further up the ridge. All that is left of the ship - a boiler, heat exchanger, and the ship's propeller lay in 85 feet. A horseshoe-shaped ledge in 65 to 80 feet opens seaward with three lava tubes, two on the west side, and one on the east.



The rare saddleback butterfly fish is most frequently found in pairs.

Bluestripe pipefish can be seen in two of the tubes along with sponge crabs, lobster, ghost shrimp, and longnose hawkfish in black coral. Hawaiian (sergeant) major fish lay eggs in abundance, and repel potential marauding from threadfin, raccoon and milletseed butterflyfish, while *ta'ape*, pennantfish, and *ulua* swim throughout the site. Pairs of large turtles, ranging from 200 to 300 pounds live here, as well as whitetips and octopus. Rare sightings of manta rays and monk seals have provided the lucky diver a jolt of excitement.

West Side

The picturesque NaPali coastline provides the backdrop for a number of sites along a seven mile stretch known collectively as **Mana Crack**. The area is conditionally accessible May through September, and offers all the advantages of pristine diving in crystal clear waters. Its northern sector has ravines that start at 65 feet and drop to over 100. Sites in the midrange depths offer crevices, undercuts and high contrast in the reef structure. Slipper lobster, porcupinefish, and tiger cowries are only part of the discoveries to be made here. There are abundant plate and antler corals, skirted by a sandy bottom with the texture of granulated sugar, and there is one very large table top coral, unusual for waters this far north. The exciting aspect to diving new, uncharted territory is the potential for unusual encounters. Blacktip reef sharks, as well as hammerhead sharks and rays, have been sighted in the area.

Vulnerable to heavy winter swells, **North Shore** diving is only available May through September. It was on my first dive here that I got to appreciate just how special Kaua'i underwater is, leaving me with a burning desire to return.

In the same way you cannot absorb all there is to see and learn about a large aquarium in one visit, **Oceanarium**, northwest of Hanalei Bay, requires several dives to get a feel for all the site has to offer. The formations are mountainous, and loaded with the usual blend of Hawaiian marine life, but accentuated with the unusual and exotic. A horseshoe-shaped cove faces seaward with a resident population of *ta'ape*. Each end of the ridge raises almost into an archway, leaving an eight foot gap between the two sides. To the east of the cove is a peninsula that levels out at 60 feet, then plummets to 140. The bluff is undercut and coated with cup corals and black coral trees. A short distance from the drop-off is a pinnacle that stands as a dive site in itself. Large, rare morwongs can be found

Kilauea Point National Wildlife Refuge

The 160 acre Kilauea Point National Wildlife Refuge is one mile off Kuhio Highway on the northernmost point of Kaua'i. It has drawn seabirds, marine critters, and between 600 to 1000 people daily to its panoramic shoreline. Brown boobies, great frigate birds, the American golden plover, and albatross have all been "watched", while over 700 red footed boobies, black footed albatross, and wedge-tailed shearwaters nest here.

Whales and turtles are frequently sighted, and one of the most endangered marine mammals in the world, the monk seal, was discovered birthing and nursing a pup on the offshore island of Moku 'Ae'Ae. A resident school of spinner dolphins has recently come under scrutiny to prevent harassment of the playful sea creatures.

The refuge's dominant lighthouse was built in 1913 to assist the trans-Pacific fleets through the Hawaiian Archipelago. It was managed by the Coast Guard, and eventually shut down, but has since been refurbished. The one and a half hour Crater Hill hike is a guided tour to breathtaking scenery, and close observations of seabirds, native vegetation, and excellent photographic opportunities in the more remote sections of the preserve. Hours are from 10:00 a.m. to 4:00 p.m., Monday through Friday. For more information, write: Kilauea Point National Wildlife Refuge, P.O. Box 87, Kilauea, Kaua'i, HI 96754, or call (808) 828-1520.

here as well as the equally rare long-handed spiny lobster. Visibility averages between 80 and 100 feet revealing other pinnacles in the distance that invite exploration. A large school of the uncommon boar fish has been sighted here as well as devil scorpionfish, anthias fish, conger eels, nudibranchs and occasionally a shark.

Blue Bluffs is a 20 minute boat ride east of Hanalei Bay, with a vertical wall from 45 to 110 feet. The top is encrusted with lobe, cauliflower, antler, and porites corals, and good for finding a wide variety of animals, common and otherwise. *Pukas* are laden with squirrelfish, shrimp and lobster. A pair of male and female turtles are consistently sighted together, which is unusual as males tend to be loners. Longnose hawkfish and Hawaiian turkey (lion) fish are difficult to find, but often seen on the lower part of the wall. Sandy flats abut the wall's base, and is the area to look for eagle and brown sting rays.

Moku 'Ae'Ae is a bird sanctuary, 300 yards off Kilauea Point National Wildlife Refuge. On the seaward side of the islet, at 60 feet, is the formation that gives the site its name, **Kilauea Arch**. The archway drops to 110 feet with caves on either side. Bright, colorful cauliflower corals have established themselves on the substrata, and octocorals abound in the 25 foot shallows. An abundance of surgeonfish graze in and about the reef. Cuts in the reef and the small vertical that drops to 80 feet, yield tiger and checkered cowries, as well as shrimp. Several pelagics may be observed, as well as turtles and sharks. Spinner dolphin and the endangered monk seal, add to the feral excitement of the dive.

Diving the **East Side** of Kaua'i depends upon the winds laying down enough to allow comfortable and safe surface conditions.

Directly off Wailua Bay is a ledge at 75 feet that drops to 120. The top of a sea mount, just past the drop-off, has large antler corals and a vast array of fish. It houses an unusual formation that serves as habitat for octopus, lobster, and an inspiration for the site's name, **Santa Claus Cave**. Divers enter a four by six foot opening at the top of the mount, leading through a lava tube 35 feet straight down, and opening into a large cavern 30 feet across and five feet high. A large entryway at the face of the ledge gives it the overall appearance of a fireplace. *Ulua's* and other transiting pelagics have been frequently sighted outside the cavern.

On March 4, 1951, the 435 foot, 8,171 ton freighter *Andrea F. Luckenbach* left San Francisco for Yokohama, Japan, and Manila, in the Philippines.The ship's captain took sick and was delivered to Honolulu, March 11th. At 8:05 p.m,the *Luckenbach* hit a submerged reef off Kaua'i, damaging her port side. In an attempt to make safe harbor at Nawiliwili, the ship went dead in the water off Wailua Beach at 11:00 p.m. She drifted inshore, and ran aground at 6:00 a.m. the next day. On August 24th, five months after grounding, she broke in two amidships, but it was another 20 years before the last of the hulk slipped beneath the surface 300 yards offshore. Today the **Wreck of the *Andrea F. Luckenbach*** lies in 25 to 30 feet, and is little more than scattered wreckage. The boiler room comes to within ten feet of the surface, with tubes three to four feet in diameter, while its large propeller, with one of its three flukes half buried, is still recognizable after 40 years of submersion. Ten foot high anchors with over 200 feet of chain remain as mute testimony to the ship's survival attempts. After a big storm, the site can often yield hidden artifacts, while schooling fish and turtles have taken up residence in the remains.

Dragon's Head is actually two one-acre pinnacles just off an elaborate ledge system that fringes the shoreline. Both rise to within 60 feet of the surface, and are festooned with black coral trees. The inshore mount is transected by a lava tube starting at 110 and exiting at 80 feet on the seaward side. It opens to a view of the other mount that gives the site its name. A suspended tongue of lava protruding from the south side of the mount resembles the dragon's head, where at 75 feet, its underside breathes a fiery spray of feeding orange cup corals. The mount has a sheer drop to 110 feet, then slopes out of sight, an open invitation to transients. Everything is big here, from the tuna to the turtles, and occasionally a gray shark.

As beautiful and splendid as Kaua'i is above the water, it is equally magnificent below.

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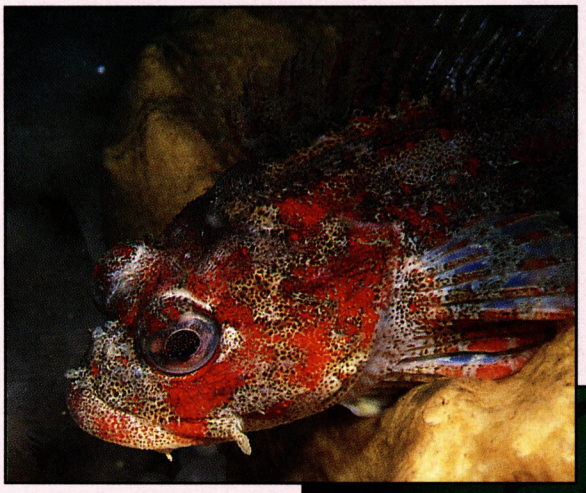
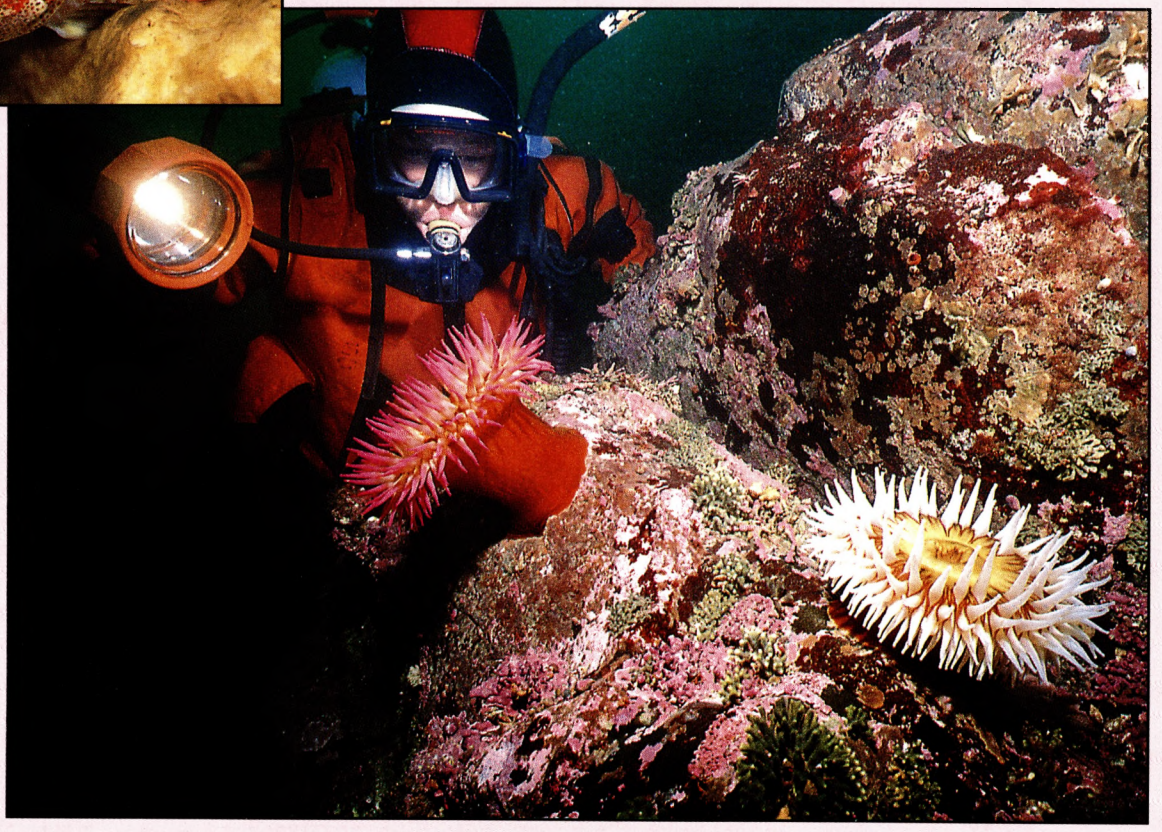
Boat Diving Washington's San Juan Islands

Part One

Text and photography by Ed Weber



Standing on the northwest coast of Washington State you can see the islands on a clear day. They are the remaining summits of an ancient mountain range which settled into the sea millions of years ago. Today, these existing mountain tops make up the picturesque archipelago of Washington's San Juan Islands. Although the number of islands is somewhat variable with the tide, it is generally agreed that the archipelago is comprised of 172 islands, rocks and islets which vary in size from automobile-sized tidal rocks to Orcas Island which unfolds to 57 square miles and rises 2,409 feet above the surrounding straits. The entire archipelago is squeezed into an area that is roughly 30 miles wide and 30 miles long.



Above *Many varieties of fish make their homes here, such as this red irish lord.*

Right *Diver and tealia anemone.*

Photo by Carl Weber

Right *Sunset in the San Juans.*

Below *The brightly hued tentacles of the aggregating anemone.*

The glacier-sculpted channels that separate these islands by sometimes only a few yards, average an incredible 600 feet of water depth. The deepest point is off Stuart Island in the northern part of the chain with a depth of 1,356 feet. The narrow channels between the islands are fed twice daily by tidal exchanges up to fifteen feet. These tidal currents flow in from the Pacific Ocean and squeeze through the channels picking up speed to create an incredible force of tidal energy.

Because of these strong currents, divers who frequent the islands must become as familiar with reading current tables as they are with tying their shoes. The National Oceanic and Atmospheric Administration (NOAA) publishes the **Tidal Current Tables for the Pacific Coast** each year. This publication provides information that can be used to calculate for slack tide. Slack is the point at which the current flow begins to slow to a stop before it reverses its direction.

Slack water provides the safest time to dive to avoid being swept off by the current. The duration of slack water is variable and is usually in proportion to the range of the tide. Maximum exchanges of fifteen feet usually provides little or no slack whereas a tidal exchange of six feet may provide an hour of little water movement.

WESTERN BOUNDARY

The second island in size to Orcas by a mere one square mile, San Juan Island is the western most island and sits on the edge of Haro Strait overlooking the U.S. border and Vancouver Island. The town of Friday Harbor on San Juan's east side is the largest town in the islands and is the county seat.

Once little more than a fishing town, Friday Harbor has evolved into a tourist mecca for travelers flocking to the islands in the summer. Where there once stood weathered cannery buildings and dilapidated docks for the rusting fishing fleet, here now stands luxury condominiums and expansive yacht marinas. Though progress has brought the advantages of fine restaurants, quaint shops and plenty of services, it has also brought with it a seasonal population boom which at times seems to crowd this small island.

San Juan Island played a little know part in U.S. history that almost escalated into war with the British. In the mid 1800's, the U.S. was involved in a boundary dispute with the British. Both sides wanted to claim the San Juans as their territory. The U.S. occupied the south cape of the island which is now known as American Camp while the British held an outpost along the island's western shores called English Camp.

In the midst of this thirteen year dispute, a Yankee homesteader named Lyman Cutler shot and killed a pig he found rooting up his vegetable garden. Unfortunately the pig belonged to John Griffin who was the British Magistrate for the island. When Griffin threatened to jail Cutler for the incident, he sought protection from the American authorities. The incident escalated into an international conflict with both sides ready to go to war over the death of a pig. Both sides wisely settled their differences and the U.S. boundary was eventually designated where it is today.

Diving from a boat is by far the best way to explore the underwater locality of the San Juans. The majority of waterfront land on the larger islands is privately owned providing little or no access to the best shore diving areas. Additionally, diving from a boat provides security in the currents when live-boat procedures are employed. Boats can also deliver you to offshore areas with better visibility, a greater diversity of marine life and more interesting reef structures.

Diving sites in the islands are almost limitless as good diving can be had just about anywhere you can enter the water. A few key hints however, may help you find the better diving areas. Unfortunately the best diving is almost sure to found in the areas of the highest current concentration. This is due to the fact that tidal currents bring in abundant nutrients and oxygen-rich waters which allows for prolific invertebrate growth. Additionally, areas of high current are usually swept clean of silt and debris which is often found in the lee or calmer areas.

The geography in the area you pick to dive may also offer clues to the type of diving present. If the shoreline drops vertical to the water's edge and little or no kelp is visible (in season), chances are the substrate will be vertical as well. Areas with extensive kelp beds often offer shallow diving usually no more than 60 feet deep. Kelp beds are also an excellent area to find fish life as they provide the fish a protective cover.

Off the south shore of Henry Island sitting adjacent to the northwest corner of San Juans island is an impressive vertical dive called **Kellet Bluff**. The crevice-laden wall here offers sanctuary for a diverse display of marine life. Anemones, seastars, Puget Sound king crabs and invertebrates of virtually every size shape and color envelope this cascading wall.

This area is also one of the few in the islands which supports a vast community of cloud sponges at the deeper depths. These ghostly looking clumps of yellow sponge are believed to live as long as a thousand years. They often provide shelter for juvenile quillback rockfish. Kellet Bluff is considered an advanced dive because of its vertical terrain and exposure to heavy currents and weather.

Off the north side of Henry Island sits a small weather-battered island called **Battleship Island**. From the distance, Battleship Island looks like a vintage World War One battleship patrolling Haro Straits with its lone pines acting as conning towers, hence its name. The island offers some interesting reef diving off its northeast side facing Speiden Channel. The walls, ledges and rock outcroppings are scattered with bouquets of metridium anemones, giant barnacles and nudibranchs. The backside of the island sits in the lee of the current and offers an expansive kelp bed in the summer months. Rockfish and harbor seals are abundant all along this side. As with many of the small islands in the archipelago, Battleship Island is a designated wildlife nesting area and it is illegal to land on shore.

Just off the northern tip of San Juan Island and smack in the middle of Speiden Channel is a reef formation that can be a nightmare for mariners but a delight for divers called **Center Reef**. The reef is heavily scarred with cracks and crevices that hide a plethora of suspension feeders, anemones, gherkins and urchins. Care should be taken while diving here because

of the heavy boat traffic and strong tidal currents running down the channel.

Speiden Island on the north side of the channel has an interesting bit of history that is worth noting. In 1970 the island was purchased by a pair of brothers who ran a Seattle taxidermist shop. They hit upon the idea that if they were to import exotic game animals from around the world, they could offer big game trophy hunting and rename the island "Safari Island." Fortunately, environmentalists and animal rights activists created enough of a howl that the operation failed and was eventually shut down in 1973. Today an occasional wild zebra can still be seen grazing near the waters edge.

These dive sites off the north end of San Juan Island are easily accessed via Roche Harbor Resort on the island's northwest side. Once a thriving lime and cement company at the turn of the century, Roche Harbor today is a very popular yachting and tourist destination with a host of services. These include boat launch facilities, groceries, a full service marina, hotel and cabin accommodations and even an airstrip.

Along the very northwestern corner of the archipelago is **Turn Point** off Stuart Island. Turn Point offers a variety of reef formations with the wall off the bluff providing a spectacular vertical dive. The wall is an absolute tapestry of marine life and is crowded with a variety of anemones, soft corals and sponge. Approximately one third of the way down the bluff from the lighthouse and resting in 60 feet of water is a large cave that is carved 50 feet back into the wall. Though penetration is not recommended, a look from the inside looking out makes an interesting sight. Stuart Island offers camping and mooring facilities at Reid and Prevost Harbors making this a great weekend getaway.

Southern Boundary

The southern boundary of the islands is wild and windswept as it is exposed to Pacific storms blowing down the Straits of Juan de Fuca. Geologically, the southern part of the islands are much sandier than the other areas of the islands which are primarily rock. Large sand dunes can be found off Cattle Point, the southern cape of San Juan Island. The southern section of the islands also separates San Juan Island from Lopez Island by the narrow and tumultuous Cattle Pass.

The navigational charts here state, "tide rips and eddies." This is an understatement during periods of windy weather and high tidal exchange. Standing water and treacherous currents can make diving hazardous. Extreme care should be taken when diving in and around the Cattle Pass area. Make sure slack water predictions are properly calculated and dive only during periods of small exchanges. The reward in diving here however, is an abundance of marine life along the many small islands and reefs in the area.

One such site is **Goose Island** just off Cattle Point on the San Juan side of the pass. The island's substrate stairsteps down into the pass with a kaleidoscope of marine life crowding the fissures in the rock. Colonies of aggregating anemones, basket stars, and soft corals can be found here. Care should be taken to avoid boat traffic and lost fishing tackle on the bottom.

The southwestern shore of **Lopez Island** has a multitude of rocks and reef structures which offer what I think is the best diving in the islands. The currents in this area are generally stronger on the ebb tide as they deflect off Cattle Point and flow directly between Charles and Long Islands. Consequently, it is best to pick the slack coming onto a flood tide.

Long Island is one of the best dives in the area. Long rock corridors with light shale bottoms curve along the underwater ledges with wall coverings of multi-colored invertebrates. The southern tip of the island extends into an underwater meadow of vibrant strawberry anemones which makes an excellent photo backdrop for such subjects as huge Puget Sound king crab, giant pacific octopus and wolf eels.

Around the southern tip of Lopez and at the entrance of Rosario Strait is **Davidson Rock**, one of the more dramatic current dives in the islands. Almost a seamount in formation, Davidson Rock can be found by the large light marker which is erected on the site. The pinnacle rises from a depth of 40 fathoms to within ten feet of the surface. The top and sides of this offshore spectacle are bursting with an incredible diversity of marine life. Tealia and brooding anemones, soft corals, sponges and a host of other multi-colored invertebrates all fight each other for space along the walls and underwater canyons of this site. As with many areas in the islands, the currents here can be tricky. Timing and patience will help make this an enjoyable dive.

In the next issue of ***Discover Diving,*** *we will complete this series by exploring the eastern boundary of the islands which borders the mainland and the exposed northern boundary of the San Juan archipelago.*

Monterey Bay

Text and photography by Gill Cruz

Five-thirty a.m., a bit early for most people, but then divers are definitely not most people. Is there any other human species who will arise before dawn, drive an hour and a half to Monterey and plunge into the cold Pacific waters, all in eager anticipation of a good dive? The sun rises somewhere near 6 a.m., and all thoughts turn to the purpose of the day: a charter boat diving trip in Monterey Bay with the hopeful added attraction of encountering some of the many whales making their annual migration south along the California coast.

This is a day that all Monterey Bay divers look for because the visibility is great and the schooling fish are abundant.

Upon our arrival at the wharf, Dennis Sabo of Landfall Products was eagerly awaiting his still sleepy trip-mates. He greeted each of us with a smile and a pleasant demeanor that was clearly a barely-concealed sadistic ritual he went through to get us in the mood for the soon-to-be-experienced boat trip. The interesting thing about Dennis' technique, smile and all, was that it worked. The *Holiday II* was now ready for us and the day's adventure.

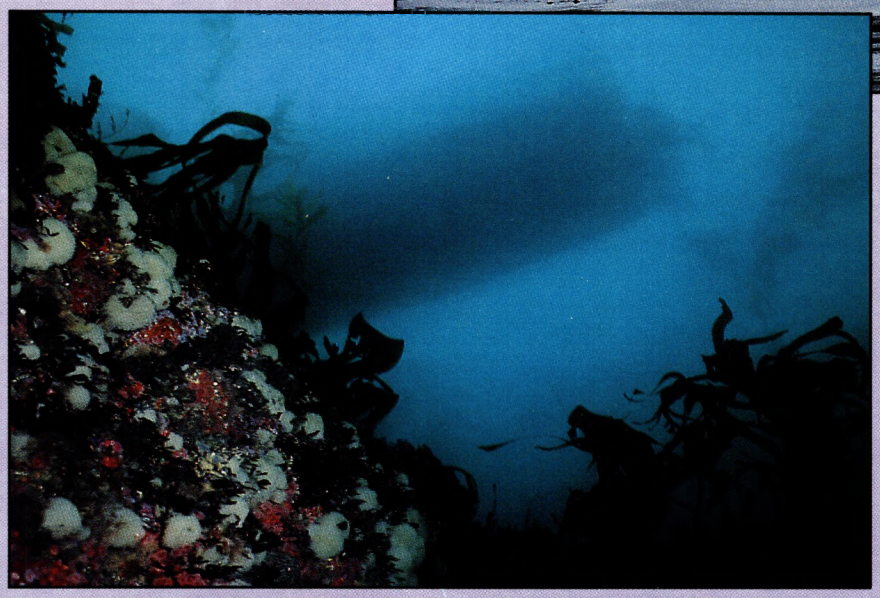
By 7:30 a.m. the gear was loaded on board, the divers finally knew where they were, every quarter known to exist in the free world was in the Monterey parking meters, and we were on our way to the first of the three dive sites.

Approximately 45 minutes later the boat anchored just off Pescadero Point, at a spot between the point and the Wash Rocks with a terrific view of Pebble Beach. Just as the divers were suiting up someone yelled for our attention. As we watched, a California gray whale breached the surface within fifteen feet of the boat. Racing for cameras proved to be an exercise in futility, since the whale had already submerged and left the area. Nobody was discouraged at missing a whale photograph, but instead all were excited and believed that the sighting was a good omen for a great dive and that good things were sure to happen during the trip.

Right *17 Mile Drive is truly a beautiful sight that anyone would enjoy as evidenced here.*

Below *Monterey Bay offers many diverse photographic opportunities depending on conditions.*

Below Right *Monterey Bay can satisfy both the wide angle and macro photographer. By taking a single subject and varying how you look at it will give a different perspective to the marine life in Monterey Bay.*



The water was as flat as it could be with visibility reaching to 45 feet. The view from the bottom presented a picture only clear water could offer, a silhouette of the dive boat with divers entering the water and fanning out to where they were going. Being able to see this sight made the photographer's lens choice wide angle.

Good visibility soon made everyone forget the chill of the water. Besides, it was impossible to feel cold when Tim, the skipper and divemaster, could be seen on board the boat without so much as a shirt or wetsuit top on. I am convinced this was a ploy used by him to psych the ever-hopeful diver into believing that he just dived overboard into some exotic warm tropical waters.

The diving in this area offered pinnacles and tunnels guarded by large white anemones. Swimming through the tunnels proved to be a startling experience, thanks to the resident harbor seals, who liked to stay near divers in hopes that a speared fish might become available for the taking. More than once I unexpectedly found myself in the company of seals who approached from my blind side to check me out for food. They were, however, discouraged and disappointed when they realized my camera was not the breakfast they were seeking.

Deeper into the crevices rocks were covered with new kelp stalks about four feet high, and coraline algae. Starfish inhabited this area in great numbers as did many fish and other marine creatures. Although none were observed on this day, it is not uncommon to spot leopard sharks in this vicinity.

Working through the kelp and rocks on this clear day we were rewarded with a panoramic view of a wide variety of sea life that cannot normally be be seen during other times of the year. The entire pinnacles were visible as were the tunnels, the kelp forests, the sandy bottom and the ledges and walls that were totally covered in corynactis. The good visibility was due to the lack of blooming plankton. This area generally offers very good diving throughout the year, except during storms or large plankton blooms.

As my air got low, I headed back to the boat, keeping my eyes open for the occasional bat ray or the large schools of fish that frequent the area. As I neared the aft landing, Tim was there to help with my gear, and Dennis was busy checking divers out of the water. With all on board, it was time to warm up and move on to the next site. While underway, we continued to anxiously scan the calm waters in hopes of spotting some of the migrating whales. After an adequate surface interval, everyone eagerly geared up for the second dive. The dive boat had anchored further up 17 Mile Drive near Cypress Point. This site proved to be every bit as enjoyable as the first, since the water was again flat and the visibility excellent. Even though the surface was relatively flat, there was a surge of about six feet. The dive site was shallow, down only to 50 feet and the visibility was about 40 feet. The terrain in this area consisted of rock ledges and small overhangs. Since the area was so shallow, the overhangs were totally encrusted with corynactis, hydrocoral, coraline algae and kelp.

The Cypress Point area is ideal for close-up exploration. During this particular dive hermit crabs were plentiful

throughout the hydrocoral and crevices, while gobies and other bottom dwelling fish practically littered the bottom. Although this site is best suited for macro photography, there is a good chance of spotting a lingcod or two nearby for the close-up and wide angle enthusiast.

Since this area is exposed to the open ocean, clear water and excellent conditions only occur at certain times, predominantly during the winter. The water temperature (53 degrees F) on this dive was warmer than at Pescadero Point (48 degrees F), however, normally the temperature is comparable.

As I approached the surface at the end of this dive, I was treated to the site of the dive boat silhouetted against the sun. The divers returning to the boat looked like tadpoles heading for a feeding session. Once on board, I was able to fully enjoy the view we had of a section of the 17 Mile Drive and the gorgeous blue sky.

At this point it was lunchtime so everyone had a good surface interval between the second and third dives. Everyone was excited about the earlier dives and was looking forward to the last one.

After lunch the boat pulled anchor and headed north. Rounding Point Pinos on our way to Chase Reef we looked out into the bay and observed the water turning dark and frothy. The skipper headed the boat in that direction so we could see what was happening. Because of the earlier sighting at Pescadero Point, we wasted no time in getting our cameras ready. We were not to be disappointed a second time. Showing great agility, a pod of pilot whales surfaced within 75 yards of the boat. First there were a couple, then as we watched over a dozen surfaced and splashed their way around the boat maintaining their distance. As we maneuvered toward the whales they allowed us to close the distance somewhat but not too much. They allowed us to parallel their direction at a distance of about 50 yards. We followed along for a little while longer, then turned toward Chase Reef for the third dive. Talk onboard was not about the next dive, but about the whales we had just observed. We all agreed that it would be difficult to top the day so far, but we moved on in hopes of experiencing even more.

Chase Reef is on the lee side of Point Pinos which provides protection from big south swells. This day it offered very good diving, because the water again was clear and there were plenty of subjects in the water to keep everyone interested. A very hungry harbor seal and many fish provided entertainment. Photography here was quite good with a large variety of subjects. On a good day both macro and wide angle can be shot. During some months the visibility can drop dramatically due to the plankton blooms, but even then it is a good dive site as there is still a lot of marine life to photograph, hunt or just observe.

Chase Reef can also be unusually exciting for those who spearfish. One of the divers found it to be a bit difficult to keep any of the fish he managed to spear. It seems there is an obese harbor seal lurking off the reef just waiting for spearfishermen to drop by, especially good ones. This particular diver speared enough fish to feed an army, but he was completely unsuccessful in bringing any to the surface. After numerous involuntary feedings of the local harbor seal, he gave up on his plans of returning to the boat with his catch and began to voluntarily feed the seal. He soon learned that his fishing companion was a selective diner who took everything except perch. Hoping to have finally sated the appetite of the pesky seal, our diver once again became hopeful of returning to shore with a tidbit or two. He spotted his first legal lingcod swimming by and speared it with his usual expertise. Pinning it against the bottom with his pole spear he carefully worked his way to the fish to pull it from the bottom. Once again, however, his hopes were dashed when his obese buddy dropped by and stole the lingcod right off of his spear. Although he returned to the boat empty-handed, our fisherman could take satisfaction in knowing that he had played an integral part in seeing that one of natures' more personable creatures was well fed for that day.

With the dive over and everyone recovered, the boat headed back to the wharf. We reached dock around 4 p.m. having learned first hand that a boat diving/whale watching expedition is one of the most exciting trips Monterey divers can experience. As more dive boats become available in Monterey, this will become an experience even more divers will be able to enjoy.

While unloading the gear at the wharf, fatigue finally set in and we were now faced with the hour and a half return drive home. However, recounting the day's activities and planning the next trip were enough excitement to belay our concerns about falling asleep while driving home.

For boat trip information, contact **Landfall Productions**, 6205 C Joaquin Murieta, Newark, CA 94560: (415) 651-6449; or contact **Aquarius Dive Shop**, 2240 Del Monte Avenue, Monterey, CA 93940: (408) 375-1933.

Dive Into History

by Henry Keatts

The only major United States warship lost in the First World War lies inverted, superstructure buried in sand, and keel uppermost. She rests in her humiliating posture, under approximately 110 feet of water, with a depth of about 65 feet to the upended keel. It is generally agreed that the *San Diego* was sent to the bottom by a mine laid by U-156, one of Imperial Germany's underwater fleet assigned to maraud the Eastern Seaboard of the United States.

Left *Cases of ammunition for the 3-inch gun inside one of* ***San Diego's*** *many magazines. Photo by Jon Hulburt.*

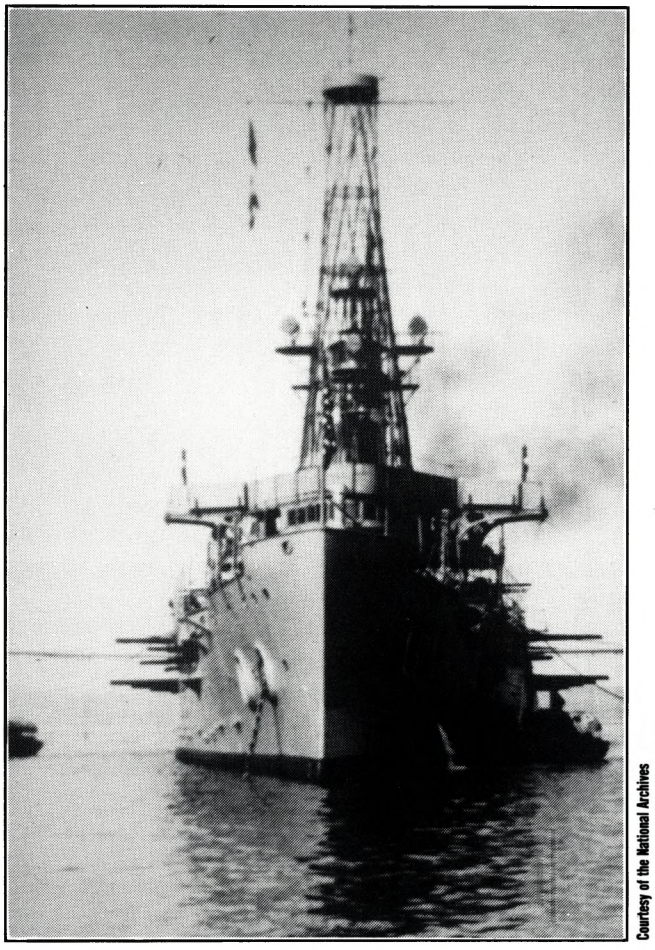
Above *The barrel of a 3-inch gun projects out of the cruiser's hull, just above the sand. Photo by Brad Sheard.*

U.S.S. San Diego

The U-boat crew forever lost their opportunity to celebrate the coup and resolve how it was accomplished when U-156 disappeared while returning to her home port. It is ironic that she was last reported trying to penetrate a massive mine field that the U.S. Navy had planted in the North Sea.

The keel of the armored cruiser *San Diego* was laid in 1902, at the Union Iron Works, San Francisco, California. Five years later she was commissioned the *U.S.S. California*. She was 504 feet in length, with a beam of 69.5 feet. Fully loaded she displaced 15,335 tons. Her designed complement was 47 officers and 782 enlisted men.

The ship's impressive armament consisted of fifty guns: four eight-inch, fourteen six-inch, eighteen three-inch, twelve three-pounder, and two one-pounder, four .30-caliber guns and two submerged 18-inch torpedo tubes.



Courtesy of the National Archives

The principle wartime modification of the *San Diego* was a reduction in her armament. The reason was two-fold; to provide guns for auxiliaries and merchant ships, and to improve watertightness of the warship for convoy duty under North Atlantic winter conditions. By 1918, several of the armored cruiser's six-and three-guns had been removed and the ports sealed.

Power was provided by two sets of four-cylinder, triple expansion coal-fired engines driving twin screws, with coal capacity of 2,685 tons. Five to six inches of tapered armor plate protected the hull above and below the water line against enemy fire. During her trials, the new armored cruiser produced 22.20 knots.

Until Congress passed legislation reserving the names of states for battleships, the armored cruiser served as the *California*. She lost that identity on September 1, 1914 when she was re-named the *San Diego*. She was in constant demand for convoy service throughout World War I. Thousands of Allied seamen and troops, terrified by the threat of Germany's U-boats, were reassured by her impressive presence as their escort on hazardous transatlantic crossings.

On the morning of July 19, 1918, only four months before the armistice that ended World War I, *San Diego* was underway to New York City from Portsmouth, NH. About 10 a.m., a look-out alerted Captain H.H. Christy to a small object moving on the surface. Its speed was faster than the prevailing current, leading to speculation that it might be a German U-boat.

The threat of U-boat action galvanized *San Diego's* gun crews into action. After several rounds were fired, the unidentified target disappeared — further supporting the belief that it was a U-boat. Look-outs were even more alert. Yet, less than an hour later, the zig-zagging cruiser shuddered from an external explosion that shattered her portside hull and two massive internal blasts that erupted in the boiler room. Her gun crews again sprang into action, firing at every real or imagined object within range -- but too late to avert disaster. The port engine was destroyed by the initial explosion. Full speed ahead on the starboard engine was ordered in an effort to beach the warship before she sank. That only hastened the

inevitable, as tons of seawater, driven into the ruptured hull by the vessel's forward speed, drowned the remaining engine.

The *San Diego* wallowed at the mercy of the Atlantic as Captain Christy ordered "Abandon Ship." Hundreds of seamen huddled in lifeboats, clung to rafts or treaded water. They watched the big cruiser slowly capsize and disappear underwater within 30 minutes of the first blast.

Close proximity to shore, quick response by rescue vessels and calm seas assured a high rate of survival. Only six lives were lost; three were caused by the initial explosion; one by a collapsing funnel; one by a falling lifeboat, and a lookout was trapped inside the cage mast.

U.S. Navy divers visited the wreck to determine the feasibility of salvage. They found *San Diego* bottom up, her keel at the bow only 36 feet underwater. A commercial salvage company, contracted to conduct a more extensive survey, found that the bridgeworks had collapsed and the top of the turrets were touching the sand. In addition, thousands of rivets had shaken loose, opening seams in the hull. Even if the gaping hole in the engine room could be patched, the wreck could never be made watertight.

The wreck lay undisturbed for more than three decades — until early in the 1950's, when a Freeport, NY fisherman returning from Montauk observed a large profile on his depth recorder. Following up that chance observation, he noted the Loran numbers and returned the following day. He had rediscovered the lost warship in 110 feet of water, already a bountiful, artificial reef, ideal for fishing.

The Navy sold salvage rights to Maxter Metals Company of New York City. Based on underwater photographs, the salvage operators planned to blow up the vessel's remains for its scrap metal value, at that time $70 a ton. Before the plan could be implemented, three concerned organizations joined forces in opposition and founded the San Diego Fund. The groups were the American Littoral Society, the National Party Boat Owners Association and the Association of Marine Angling Clubs. Their mutual objective was to preserve wrecks as marine habitats. The destruction of any offshore wreck would defeat that purpose. Their effective lobby convinced the Navy to cancel the Maxter contract and adopt a policy that the *San Diego* would remain undisturbed—never again to be offered for salvage.

The starboard propeller was freed from its shaft with explosive charges by a group of unauthorized divers, but the Navy intervened, and it was left lying on the bottom. While the authorities were monitoring the 37,000-pound bronze relic, a group of six divers discovered that the port drive shaft had broken and the propeller was laying in the sand. They made off with it using a 200-foot tanker that had been converted into a salvage vessel. They rigged the propeller under the hull and started towing it toward Staten Island, NY. However, the propeller broke loose and was lost when it dropped to the bottom.

After the furor died down, a Long Island diver, operating under a salvage contract from a private group, attempted to raise the remaining propeller. The operation was set up with professional attention to detail, and a barge equipped with an A-frame, to raise heavy objects. Equipment included underwater cutting gear, burning bars, a 600-cubic-foot-per-minute air compressor, 25 sets of doubles, 60 air storage bottles and oxygen bottles.

The divers had lifted a large amount of bronze from the wreck before they rigged the propeller for lifting. It was to be the last item of salvage, a 37,000-pound artifact. As the propeller was being raised, it fouled on a strut. Before the operator could declutch the crane motor, the A frame was overstressed and its starboard leg was forced down four to five inches, opening a leak in the hull of the 700-ton barge, *Lehigh Valley 402*. Despite energetic pumping by the crew, water came in faster than they could pump it out. The 140-foot barge, a sizable wreck with a 45-foot beam and a large, 25'x20'x25' deck house, with all its expensive equipment, plummeted down to join the *San Diego* on the bottom.

The barge, now broken up, still rests where she sank within 100 feet of *San Diego's* starboard stern, a favored source of over-sized lobsters for "bug-gathering" divers. The elusive propeller was eventually retrieved by others, who benefited from having had most of the labor performed for them.

The huge opening created by the German mine allows easy access to the engine room and its artifacts. The internal explosions that followed the initial blast left another gaping hole that provides easy entry into the boiler room.

Winter storms and the corrosive ac-

tion of the sea continue to open new sections of the wreck, providing access to additional areas of the ship's interior each year. She offers a constantly-changing cornucopia of souvenirs for sport divers, and her easy access, close to the shore of Long Island in only 110 feet of water, has made her one of the region's most popular charter boat dive sites. Artifacts abound, but because it is a relatively easy dive with so many attractions to divert the unwary, care and common sense must be exercised. Five divers have lost their lives inside the wreck—running out of air before they could find their way out.

The interior of the *San Diego*, like any shipwreck immersed in seawater for six decades, is no longer recognizable as a ship. Some bulkheads and partitions have collapsed, and in some areas, decks have rusted through. Piles of debris and twisted wires, cables and conduits are scattered about—like an underwater junkyard. Layers of silt and sediment vary in depth from one inch to several feet throughout the wreck. When divers swim through such an interior, their fins stir up that loose material and cloud visibility. All familiar landmarks cease to exist.

Most experienced divers use a reel with several hundred feet of line, tying off the loose end where they enter the wreck. When the penetration is finished, the line is reeled in as they follow it back to the wreck's exterior. It is noteworthy that those divers who lost their lives within *San Diego* did not use penetration lines.

Dangerous temptations and potential hazards greet divers who enter the ship's magazines to retrieve ordnance that includes live ammunition. Many find powder canisters for the 6-inch cannon, oak cylinders trimmed with copper and brass. Those cannisters contain raw silk bags of compressed gun powder pellets. Vast quantities of other live ammunition have also been removed—to adorn walls, mantles, and tables in the homes of divers, friends or relatives.

In June, 1982 the Suffolk County (NY) Police Bomb Squad confiscated a 98-pound piece of ordnance that had been retrieved by a sport diver. The projectile for a 6-inch gun contained 55 pounds of explosive. The object was too large to be handled at the Westhampton Beach Police bomb site and was transferred to the Army Ordnance Division for detonation at Fort Dix, NJ. That action aborted the plans of the misguided diver who had intended to sandblast, polish and place the live projectile next to his fireplace. If it had reached the fireplace, the demolition of his own home and his neighbor's might have followed. The cruiser, *San Diego*, still caries the potential destruction for which she was designed.

The Navy reacted to the incident through Lt. Joseph Tenaglia of the Naval Explosive Ordnance Disposal Team from the Earle Naval Ammunition Department, NJ. A cadre of U.S. Navy personnel have received highly specialized training in dealing with unexploded ordnance. Lt. Tenaglia and a team of Navy divers toured *San Diego's* ammunition room, guided by Stephen Bielenda, noted Long Island Scuba diver, and me. The Navy concluded that the ordnance rooms should be sealed against further removal of live ammunition to prevent divers from endangering, not only themselves while underwater, but also their families, friends, and neighbors. That action has not been taken and it probably never will be.

Armored cruiser *San Diego* lies dormant—but dangerous. She invites examination by the curious, and assesses a terrible penalty on the foolhardy or careless.

Henry Keatts is Professor of Biology and Oceanography at Suffolk County Community College, Long Island, New York. In addition to being widely published in his field, Keatts is the author of ***New England's Legacy of Shipwrecks*** *and* ***Field Reference to Sunken U-boats****, both published by the American Merchant Marine Museum Press (U.S. Merchant Marine Academy). He is co-author of the* ***Dive into History Series*** *published by Pisces Books, and his new book* ***Dive into History: Warships*** *is now available in dive shops, or from Fathom Press, P.O. Box 191, Eastport, NY 11941.*

The Solomon Islands

by Ken Loyst & Jolee Brunton

In *Discover Diving's* ongoing search to provide our readers with information on the best world class diving, this year's adventure took our group to the Solomon Islands. A country forged on war, the Solomons host a diver's dream of spectacular WWII wrecks and post-war military dumping sites, reefs with a greater number of corals species in one area than in most of the world combined, and walls flourishing with marine-life. We dived the Guadalcanal World War II wreck sites for two days followed by a ten-day liveaboard dive cruise aboard the *Bilikiki*.

Getting There

Our group assembled from all parts of the country at Los Angeles International Airport to board a Qantas 747 headed for Fiji. Sixteen hours of crossing the Pacific Ocean, with an hour stop in Hawaii, brought us to Nadi, Fiji ready for our lay-over day. We had lost a day in transit to the International Date Line and had to wait another day for the scheduled Air Pacific flight, though the prospect of spending 36 hours in Fiji didn't sound all that bad. We did, however, run into a few difficulties.

Our Fiji base was the Dominian hotel which greeted us without running water. Most of the group spent the morning waiting to take showers in the fleeting moments when water became available. We were informed Air Pacific changed their return flight time and all the return tickets had to be changed from Qantas to Air New Zealand. (We found out that Air Pacific is notorious for changing or canceling flights, more on that later.) But how could we let such minor difficulties ruin our vacation in this beautiful place? We didn't. The group rented a couple of cars and we set out to explore Fiji's Coral Coast — a day filled with shopping, photographing, and visiting one of the world's most beautiful coastlines.

The next day had everyone anxiously awaiting the flight to Honiara, the capital of the Solomon Islands, on the Island of Guadalcanal. An hour and-a-half mechanical delay didn't even dampen spirits because of the anticipation of starting the next day diving World War II wreck sites. We arrived in Honiara after a three and-a-half hour flight and were met by Rick Belmare, owner and operator of **Island Divers** and the *Bilikiki* dive boat. Rick's crew loaded half a ton of dive and camera gear into a flat-bed, then packed everyone into two vans and drove us to the Mendana Hotel. The Mendana served as our next base of operations and housed **Island Divers** on site. The Mendana is considered to be the best hotel in Guadalcanal. Tourism is relatively new to the Solomans, and so accommodations are not what one would term luxurious. Adequate is a more appropriate adjective. The rooms were clean, but musty smelling. They were air conditioned, which was very much appreciated as Guadalcanal is tropical-hot and humid. The restaurant at the Mendana was good, serving a buffet breakfast and lunch with different local and European dishes. Everyone at the hotel was friendly, courteous and helpful.

Our first experiences in Guadalcanal were to be underwater adventures followed by a land tour of historic sites.

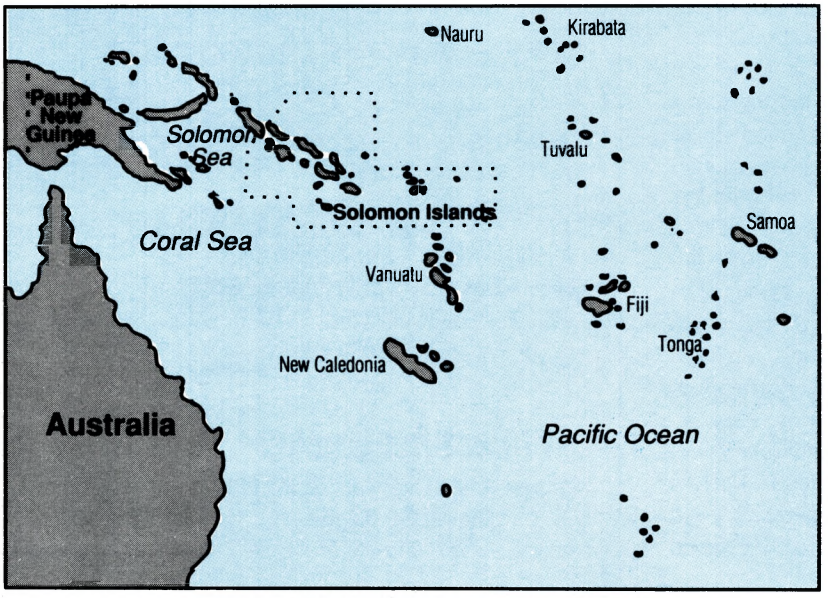


Photo by Ken Loyst

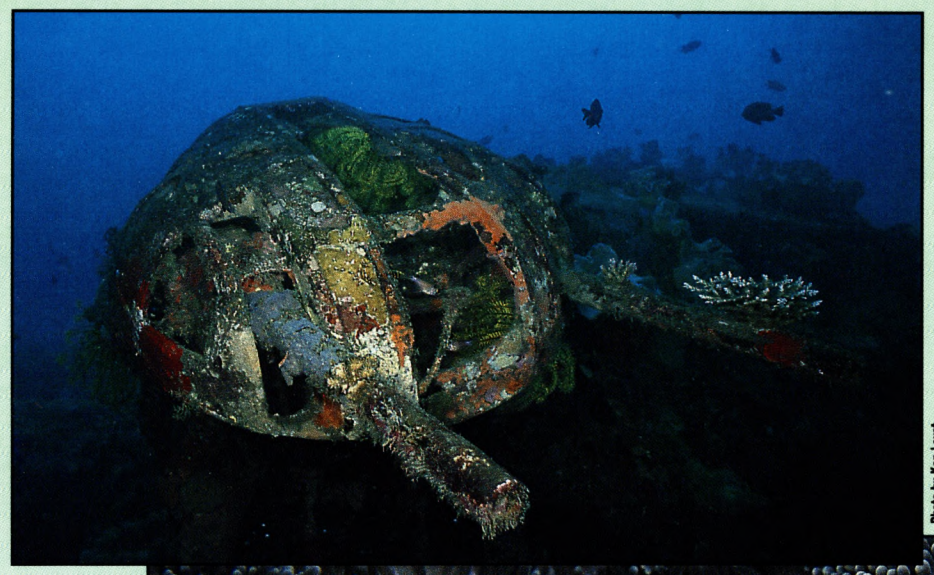


Photo by Ken Loyst

Above *The east end of Guadalcanal Island at Tambea Bay, near Cape Esperance where the Japanese withdrew from the island during World War II.*
Left *A view of the gun turret on the B-17 Flying Fortress just 14 miles outside of Honiara.*
Below *Anemonefish take refuge among the stinging tentacles that offer them protection. These scenes are found throughout the walls and reefs of the Solomon Islands.*

Photo by Ken Loyst

DIVING GUADALCANAL

Our crowd of eager divers with a dozen loaded cameras piled into the Island Divers' vans. The promise of a Japanese transport as our first dive set the tone of the morning's excitement. The locals called the site the **Bonegi I**. Believed to be the *Hirokawa Maru*, this 568 foot wreck starts in 10 feet of water and continues down the reef to 180 feet. The deeper parts of the wreck were the most structurally intact. She was beached November 14, 1942, after being attacked by U.S. dive bombers. Bonegi I is the largest of the shore dived wrecks on Guadalcanal, and like all of the beach sites, easily accessible from shore. This wreck was covered with tropical fish of all sizes, shapes, and colors.

Photo by Ken Loyst

Photo by Jolee Brunton

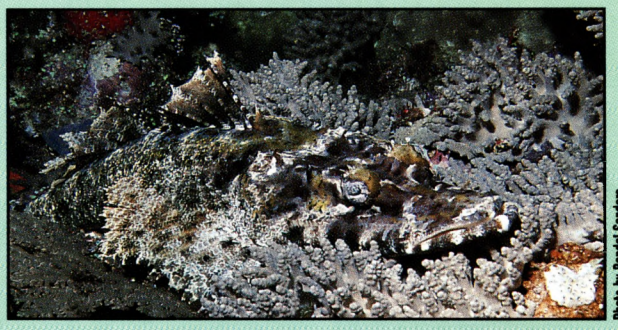


Photo by Randal Sanders

Photo by Jolee Brunton

Left *A close-up shows the intricate beauty of a soft coral.*
Top *This hawkfish poses on a coral branch as it awaits unsuspecting prey to swim within its reach.*
Middle right *A rare crocodile fish blends into its coral backdrop displaying the art of camouflage.*
Bottom right *A hermit crab eyes the camera.*

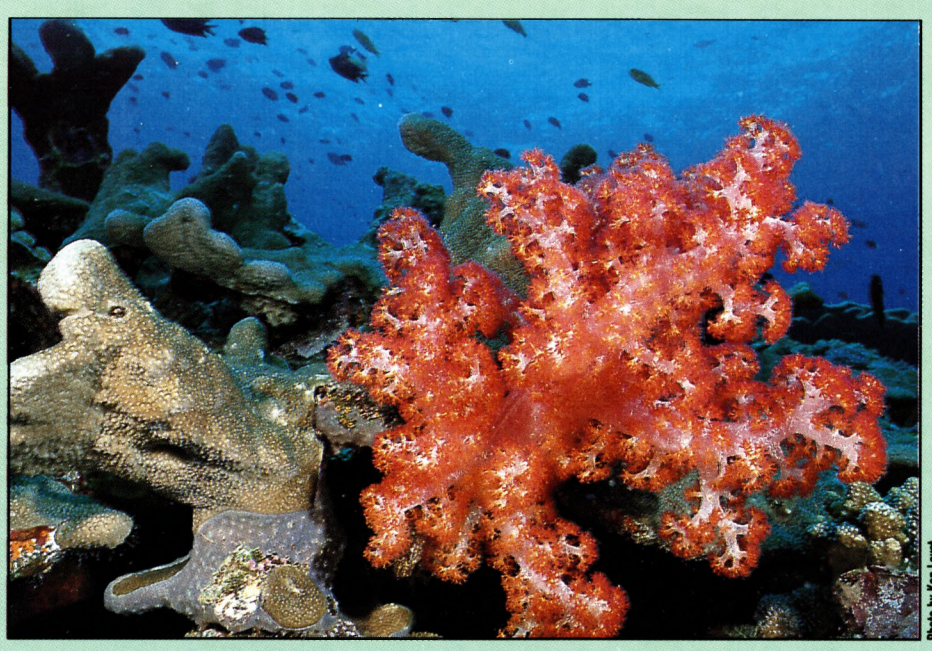


Photo by Ken Loyst

Top left *A typical view of soft coral atop the reef in the Russel Group.*
Bottom left *Buttercup coral photographed on a night dive in the New Georgia Group.*
Top right *This colorful egg mass was found on a wall dive in Marovu Lagoon.*
Bottom right *Looking out from the cave on Leru Island.*

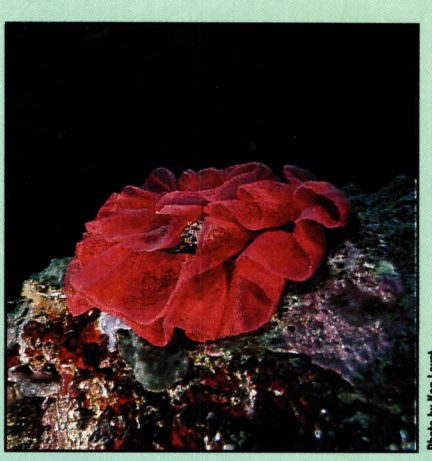


Photo by Ken Loyst

Photo by Ken Loyst

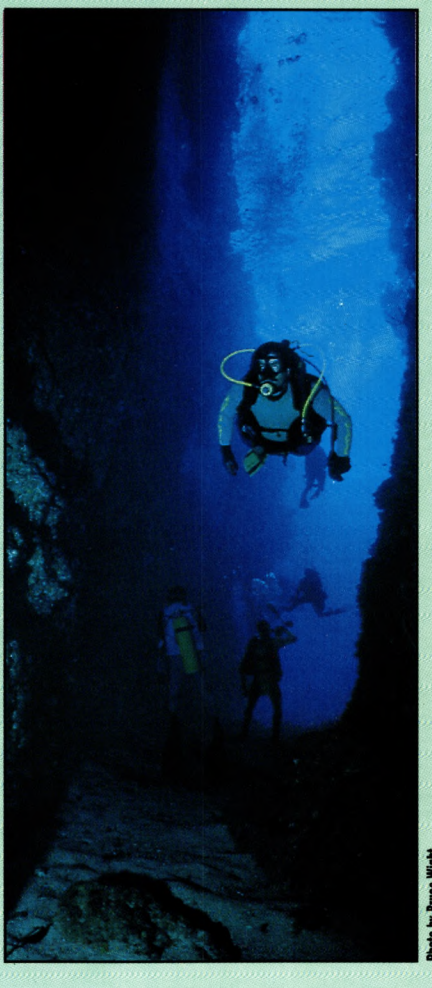


Photo by Bruce Wight

Our second dive of the day brought us to **Bonegi II**, only a few hundred yards away from the first site. This Japanese 436-foot transport, the *Kinugawa Maru*, rested partially above water, with the stern in 80 feet. The Bonegi II shelters several large black and white lionfish and is teeming with reef fish. The wreck has been reduced to a skeleton at the top, and offers a maze of angles, jutting ladders, and perpendicular beams. Nudibranchs could be found as well as sea fans and corals.

We began our dives early the next morning so that we could take a war memorial tour of the island that afternoon. The first dive was on the third Japanese transport called the ***Ruiniu***. A dozen Solomon children gathered around us upon arrival at the beach. Soon we had over a hundred kids watching us in awe as we suited-up for our dive. They stood staring skeptically as we entered the ocean. Extremely tame reef fish greeted our divers at the superstructure of the wreck. The *Ruiniu* began in 25 feet and plunged to 150 feet and, like her sister ships, was encrusted in hundreds of varieties of corals, both hard and soft.

Photo by Ken Loyst

Left *Ammunition, left naked from its disintegrated wooden cases, is found covering much of the bottom of the* ***Lever Point Dump*** *site.*

Below *One of the many military vehicles found underwater at the* ***Lever Point Dump*** *site, this coral-encrusted jeep still had its windshield intact.*

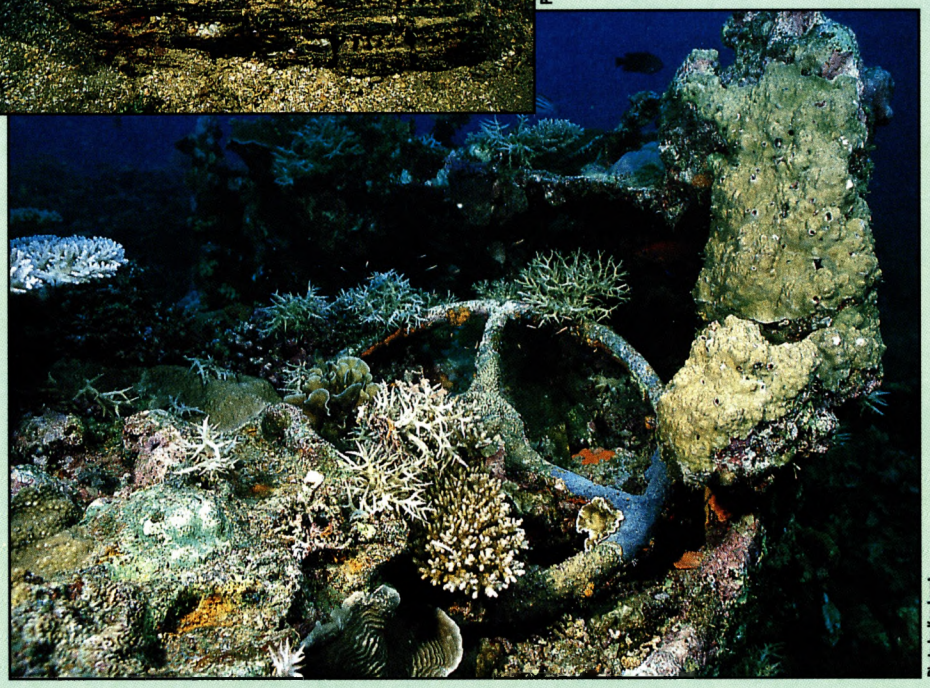


Photo by Ken Loyst

The morning's next dive was a half-hour drive away and treated us to a very special wreck site — a **B-17** American Flying Fortress lying in 55 feet of water. This outstanding plane wreck covered in soft corals still had its machine guns intact, pointing upward to the surface. Divers were able to go inside the fuselage amid a cloud of silvery fish, or sit in the cockpit in the nose and work the controls. The ailerons on the wings still moved, as did the big propellers. Sitting upright in the sand (home to a field of slowly "dissolving" garden eels), this B-17 was truly a photographers dream site.

Photo by Ken Loyst

Curious Guadalcanal children watch as Bruce Wight gears up to enter the water.

Guadalcanal Topside

Guadalcanal is the largest of the Solomon Islands with a population of over 70,000. Known in Pijin (the native language) as Galekana, Guadalcanal was originally called Wadi-al-Canar by its Spanish discoverer who named it after his home village in southern Spain.

Our stay on Guadalcanal was a trip into history. Jungle covered gun installations were seen, quonset huts from the war were the foundation of Honiara, and war memorials were everywhere. The island was lush-green beautiful, with a network of hills and valleys growing from the coastal plains into steep mountains over 7,000 feet high.

The most compelling evidence that this country was forged from war was the quonset hut township of Honiara becoming the capital of the Solomon Islands after the war ended. Virtually nonexistent before the war, Honiara has now become the economic center of the Solomon Islands, due in part to the U.S. military building a road around the island. Bridges constructed during the war are still in use today, and Henderson Field is Guadalcanal's international airport. A recently developed tourism market and a new central shopping mall gave the aura of a boom-town to Honiara, though most of the stores were empty when we were there.

World War II

The peaceful pattern of tropical paradise was destroyed by the Japanese invasion in 1942. Guadalcanal was to be Japan's jumping off point to attack farther south into the Pacific Ocean, including Australia. The Japanese alienated the local people from the beginning, prompting the peaceful islanders to side with the Allies. The invading Japanese stole food, robbed and defiled churches, and seized adult males to make them work at gun point. Their worst violation to these islanders was looting the locals' gardens, the main source of family food.

U.S. troops landed on Guadalcanal a month later to stop the Japanese in one of the war's most famous and bloodiest campaigns. Six major naval battles were fought sinking over 65 principal warships and transports giving the waters off Guadalcanal the nickname of "Iron Bottom Sound". World headlines glorified famous battles fought ashore like Bloody Ridge, Henderson Field, Red Beach, and Hell's Point. U.S. and Allied casualties were heavy, but Japan's were substantially greater. The Japanese secretly withdrew from Cape Esperance in February 1943, after six months of desperate fighting. Thousands of islanders came to Guadalcanal after it was secured and helped build the new U.S. supply base at Honiara. Guadalcanal was the first major defeat for the invincible Japanese forces. It was considered the turning point of the war.

Remnants of the war were everywhere. Quonset huts have been converted to stores, houses and garages; rusting artillery could be spied through engulfing vegetation; coconut palms had holes completely through them, scars from intense shelling of the beaches. Although none of us were alive during WW II, Guadalcanal brought his-

tory into the present, making the War seem like it had happened yesterday.

Our tour was impressive, giving us all a little more insight into the history of the Solomon Islands. This is a land where you can truly absorb yourself in history.

The *Bilikiki*

Early Sunday morning we were packed into vans again and brought to the docks. The liveaboard *Bilikiki* became our home for the next eleven days. The *Bilikiki* is a 127 foot converted Taiwanese fishing boat that was used by the Solomon Islands government as an inter-island 250 passenger vessel. Rick Belmare, a NAUI instructor and dive guide since 1978, joined-up in partnership with Roger Radford, a ship builder in the Solomon Islands, to acquire the *Bilikiki* and turn it into a first class liveaboard dive boat. The boat was completely stripped and re-designed keeping their future diving customers in mind. Ten deluxe air-conditioned staterooms were built forward of the engine compartment, each containing a double and single bunk, storage space, and a private head with sink and spacious shower. One deck up incorporates a large diving deck aft, the ample galley, then forward to the inside dining area, the outside dining area and sun deck, and the crew's quarters all the way forward in the bow. Up another flight of stairs brings you to a sun deck forward, the wheelhouse (and library), the photo room (with E-6 processing), a laundry room, and more crew's quarters. And, up yet another ladder brings you to another massive sun deck. This liveaboard has plenty of space!

Since its first departure on November 1, 1988, the *Bilikiki* has never missed a sailing. According to Rick, they will leave with only one paid passenger aboard and have done so with two. The average number of passengers have been ranging between 12 and 15 for the last year. The *Bilikiki* is limited to 20 divers and carries a crew of 12. The managing divemasters for our trip were expatriots William and Uli Odling, a superb team that made everyone's trip much more enjoyable. The crew is first rate. Staterooms are cleaned daily. There is no need to touch your gear: It is washed, hung to dry, and re-assembled each dive. Other amenities included fresh towels every day, separate wash tubs and storage areas for cameras, individual gear storage on the dive deck, a 24-hour urn of hot water for tea, coffee or cocoa, and accessible snacks between meals (popcorn and cookies!).

A description of the pleasures aboard the *Bilikiki* would not be complete without mentioning the excellant cuisine. The food was alway fresh, plentiful and very tasty. Menu items included sautéd fish in wine sauce over rice, eggplant served with raisins and onions, pasta salad with chili tuna,gingered chicken fetuccine, pumpkin baked in coconut milk, roast lamb with mint jelly, and other equally as tempting entrees. Each meal was accompanied by a large green salad and homemade wholegrain bread. Deserts were wonderful cakes, fruits with chocolate sauce or creme fraiche, and ice cream. William and Uli are very proud of the cook, and say they do everything they can to keep him happy!

Diving From the *Bilikiki*

The *Bilikiki* works in the mother-ship fashion. It anchors or idles several hundred yards from the reefs and ferries divers from two tenders affectionately called the "tinnies". Pre-assembled tanks are loaded into holes on the wide aluminum seats. These beamy aluminum tenders then drop divers at the prime site of a reef or wall, usually up-current on a point. The amazing thing is that there is always a tinnie ready to pick you up upon surfacing, no matter what direction or how far you wander off. The tinnies are relatively easy to climb back onto because of their their low freeboard and the crew haul your tanks and belts aboard. Each of the tinnies are also equipped with a stern boarding ladder. This mother-ship type of diving made it very convenient to dive the Solomon Islands.

Our diving was divided between two provinces, the Central Province which contained the Russel Group of islands, and the Western Province including the New Georgia Group and Marovo Lagoon. The first group visited was the Russel Group where we called on 19 different islands and made over 24 dives. We stopped at 11 islands in the second group for another 20 dives. Following is a highlight of each of these areas.

Diving the Russel Group

A five and-a-half hour crossing from Guadalcanal to the west leads to the Russel Group of islands in the Central Province. Two main islands and over 50 smaller islets make up the Russel Group. Most of the smaller islets lie to the north and the east of the larger Pavuvu and Mbanika islands. Several of the islands are covered in coconut palms and the larger islands have coconut plantations on them.

We were the second group that had the privilege to dive these island off the *Bilikiki*. They had been opened up for diving just a few weeks prior to our arrival. Most of the sites had already been dived by our divemaster William, so, he knew "where the action was". We would make two dives the first afternoon.

Our first dive site, leading to first impressions, was **Kisan Island**, a low profile island with pines and palms scattered about. We dived the lee side because of the large southerly swell. This was a wall dive — like most of the dives in the Russels. The wall was sheer. It began at the surface and plunged down to depths hundreds and hundreds of feet below. It was not as colorful as Honiara. There were no soft corals or sponges to speak of, but hundreds of varieties of hard corals. **Lologaan Island** was the last stop of the day and very similar to Kisan Island. The same sheer walls, a multitude of hard corals, and the lack of soft corals. There was a good supply of anemones and anemonefish on the wall making great close-focus, wide-angle photo subjects.

The next day we motored to **Kau Kau Island** during breakfast. After eating, we dived the northern point (another wall). This was our first glimpse of palegics. A green sea turtle, a large tuna, and a few silver tip reef sharks became photo favorites. Unlike other areas of the world we had been to, the white tips seemed to be less friendly, skittish, and afraid of the bubbles. The standing joke among divers in the Solomons when someone brings up the subject of sharks is "There are no sharks, the saltwater crocodiles ate them all". We had the privilage of observing a ten-foot saltwater crocodile at our anchorage during lunch. Our divemaster was worried that we wanted to get some underwater photos of this speciman. That became our standing joke.

The next few days lead us to several island dive locations including **Koemurun Island**, **Samsaeon Island**, **Karumulun Island**, **Mane Island**, **Kovilock Island**, **Lisamata Island**, **Fonagho Island**, **Ilailaon Island**, **Mborokua Island**, **Aeaun Island**, and **Sililoma Reef**. We typically dived on the points of these islands, sometimes diving more than one site.

The highlights of the Russel Group, however, were two special dive sites. The **Lever Point Dump** was uniquely memorable because it was a post World War II military dump site. Millions of dollars of military equipment and munitions lay scattered on the bottom encrusted in hard and soft corals. The photo opportunities of jeeps, half-tracks, trucks, bull-dozers and ammunition of all calibers were so numerous that there wasn't enough film available for all of the subjects. This PT boat base dump is a must see dive site. The cave and wall at **Leru Island** was the other noteworthy dive area. The cave made a deep cut into the island and offered several photo studies of unusual sea-life. The accompanying wall plunged into sheer steepness past limits of visibility and was clouded by huge schools of rare reef fish. Multicolored softcorals clung to the wall defying the same current that brought its food.

The Russel Group was not dissapointing. Each island dive site had its own special features of interest. Each worth the 70 or 80 minutes spent exploring the walls and reefs associated with it. Reef sharks, spotted eagle rays, lionfish, crocodile fish, and even mating turtles kept our attention on many of the dives.

After seven days of diving the Russels, we headed back to Guadalcanal to pick-up five more of our group that had been delayed in Fiji two days because of a cancelled Air Pacific Flight. Now we would have a twelve and a-half hour crossing to the Western Province. We were going to dive the New Georgia Group and Morovu Lagoon.

Diving the New Georgia Group

Twelve well populated larger islands in combination with a considerable number of smaller islets make up the New Georgia Group. Fringed by Roviana Lagoon to the south and Marovu Lagoon to the east, the largest land mass here is New Georgia Island. Our concentration of diving would be around Marovu Lagoon, the world's largest island-enclosed lagoon.

Most of New Georgia Island's population lives along the southshore boasting the Solomon Island's most prolific wood carvers. Our group brought back several samples of these carvings leaving an economic boom to some of the small villages we visited.

A low pressure system kept the sun away and a constant downpour tried to dampen everyone's spirits, but we all knew that the diving would brighten up our day. Thankfully our expectations weren't lost in the disagreeable weather. Our initiation to the New Georgia Group was **Karuniou Island**. The greater abundance of soft corals and sea fans was the first noticeable difference between the New Georgia and the Russel groups. Fish seemed more plentiful as well, but they were as shy as their cousins in the Russels, making them as difficult to photograph. The dissimilarity of diving topography among the two groups was diversified enough to keep our inter-

est, however, as a general rule, the Russel Group had deeper sheer walls, while the New Georgia Group had shallower reef areas.

Because of the constant heavy rain, our visibility was not as good as it had been in the Russels. We stopped at **Njapuana Island**, **Vangunu Island**, **Nggatokae Island**, **Mbulo Island**, **Malemale Island**, and **Kicha Island**, making several dives at each island, usually on different points. We started noticing more reef sharks and turtles on our dives. Turtles were even approaching our divers to bring them on a friendly tow, or to have their shells rubbed. Maybe it was because the Marovu Lagoon area has had a greater frequency of divers that these reptiles have grown accustom to the presence of humans underwater. Whatever the reason, they were more often attraced to our divers than frightened away.

The memorable dives of Marovu Lagoon were frequent. A Japanese freighter off Vangugu Island was particularly interesting, its hold filled with military supplies. Even more significant of an experience was the exploratory dive conducted to find another purported Japanese freighter only two hundred yards away. The crew dragged a grappling hook finaly snagging something on the muddy bottom. We dropped in divers that confirmed the find as another Japanese freighter. We were rewarded by a wreck that was untouched. It was obvious that this freighter hadn't been found previously by salvage divers. Portholes, plates, cannon, and personal effects were all still intact. This was definitely a dive to remember.

The last day of diving brought with it the sun again. We had made 15 dives around Marovu Lagoon and it was time to return to Guadalcanal. There were many experiences that we would all treasure for years to come. Everyone was retrospective as we pulled away from the last island for our 15 and a-half-hour crossing.

THE DOWN SIDE

Into every life a little rain must fall, and into every vacation a few problems must be overcome. Here are some we encountered:

"It's Never Like This"

No matter what anyone tells you, there is a swell in the channels between islands that results in significant boat movement, side-to-side as well as stern-to-bow. The crossings were rough, and while no one was actually nauseated to the point of no return, several of the group made the crossings flat on their bunks wishing they were back in Kansas. The crew maintained that this was the roughest seas they had encountered in years, but others we talked with had the same experience we did. The crossings were not bad enough to deter from the overall wonderful experience of the Bilikiki, but don't count on glassy seas.

Don't Worry, Be Healthy

The Solomon's are the malaria capitol of the world, with the predominant strain being resistant to chloroquine, the most readily available protection. It is estimated that up to half of the population is infected. Malaria is spread through mosquito bites, and mosquitos are active between dusk and dawn, so be sure to dress with long sleeves and pants, and/or use insect repellent. Many hospitals and clinics in the U.S. have travel clinics where a doctor will inform you of all recommended immunizations for the area in which you plan to travel. Use a travel clinic or consult your physician at least a month before you plan to leave. To prevent malaria you must begin treatment two weeks before arrival in the Solomons and continue for four weeks after you leave the area. It is a good idea to have your doctor prescribe emergency medications as the hospital/health care facilities in the Solomons are somewhat primitive.

Another health consideration for tropical areas in general is salt water ulcers that can occur when a cut is consistently exposed to salt water and humid conditions. We spent as much as five hours per day in the water, and found that nicks, cuts and scratches quickly became infected and ulcerated. Be careful around coral, and watch areas that are chaffed by wetsuits, booties, and BC straps. Alan Jones saved the trip for one diver with an open sore on her ankle by suggesting she use grocery store freezer bags as bootie liners, eliminating a painful chafing problem. Take an antibiotic wound cream such as Neosporin and an antiseptic such as Betadine, as well as an ample supply of bandages for treating wounds.

Island Time

When you only have two weeks for vacation it can be extremely frustrating to have flights cancelled and delays, but outside the U.S. that can be the rule rather than the exception. Air Pacific is notorious for cancelling flights at the last minute if the flight is not full enough. Trip insurance can save you the expense of a lost vacation. Keep in mind that the principal religion in the Solomons is Seventh Day Adventist, and so, many business services are not available on Saturday. Make your travel arrangements accordingly. Relax, take it easy. Time moves slowly in the Solomons.

World Class

The outstanding diving of the Solomon Islands aboard the *Bilikiki* is world class diving. The boat, crew, food, and accommodations are exceptional and worth the investment for a first class vacation. The area is remarkable enough to plan on at least two weeks of vacation time. At this writing, the *Bilikiki* is still owned by Rick Belmare and Roger Radford despite the rumors published in other sources that it had been sold to an Australian company.

Trips aboard the *Bilikiki* can be arranged by contacting **Tropical Adventures** at 1-800-247-3483 in Seattle, or **See and Sea Travel** at 1-800-348-9778 in San Francisco.

Next year ***Discover Diving*** *magazine is planning to dive the Island of Sipadan off of Borneo, Indonesia in late July. We are also going to re-visit Fiji's northern group of islands in late September. Join us if you're inclined to have some fun, do lots of diving, and shoot heaps of photos.*

LOG ENTRY

By *Robert Yin* **Buddy** *Jim Rakowski*

Photography by *Robert Yin* **Date** *9/24/89* **Dive No.** *2598*

Location *Yellow Tail Alley, San Bonitas Islands, Mexico*

Visibility *60 feet* **Depth** *30 to 80 feet* **Conditions** *Slight surge*

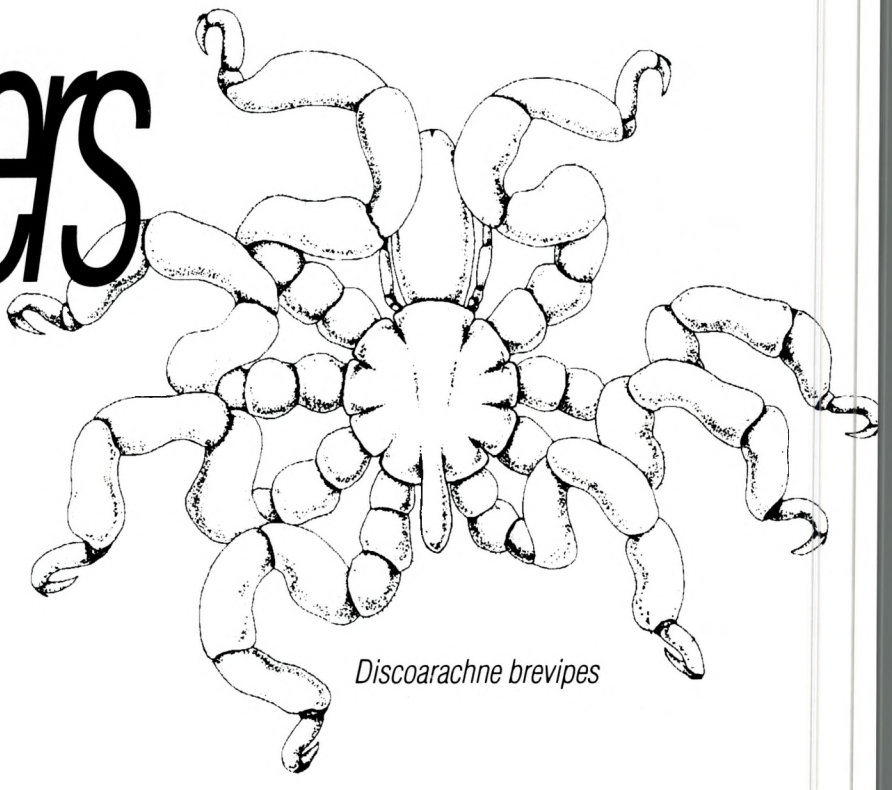
From the dive boat Sand Dollar, anchored on the lee side of the small island, Jim and I slipped down through the palm kelp. Through the kelp, deep ravines containing a great assortment of animals such as snails, moray eels and garibaldi were visible.

As we continued our descent, we came to an area with large pinnacles; some of which started in about 45 feet going down to 120 feet. On some of these pinnacles I found exceptionally thick hydrocoral (Allopora californica). Leveling off at 60 feet, we tried to capture on film the garibaldi darting around the pink and purple hydrocoral.

On our way up, we swam through a large school of 30 to 40 pound yellowtail. At thirty feet, we encountered a large school of Sargo (Anisotremus davidsonii). They appeared to be mating as some were "flashing", but they did not appear bothered by me approaching to within two or three feet.

As we made our safety stop, a pair of kelp crabs, clutched in what appeared to be a mating embrace, provided the perfect opportunity to finish off my roll of film. Another excellent dive!

Sea Spiders



Discoarachne brevipes

TAXONOMY

Kingdom:	**Animalia**
Phylum:	**Arthropoda**
Class:	**Pycnogonida**
Order:	**Pantopoda**

by Robert von Maier

I admittedly am not a fan of spiders. However, my disquietude applies to the terrestrial types, not the marine variety. In fact, the two have little in common except for a slight morphological resemblance and a name that conjures up thoughts of arachnid-filled sleeping bags somewhere in southern Mexico.

As members of the phylum arthropoda, sea spiders possess the characteristic encasement of armor known as exoskeleton, which gives the animal rigidity and protects its soft, internal body parts. The exoskeleton is made of a substance called chitin, which is secreted by the underlying epidermal cells. As stated in **The Audubon Society Field Guide to North American Seashore Creatures** by Norman A Meinkoth, "The exoskeleton has joints, regions where the chitin is thin and flexible, permitting movement. Such joints are particularly obvious on the legs, and give the phylum its name, Arthropoda, which means 'joint foot' in Greek."

Those members of the arthropoda known as sea spiders are grouped into the class pycnogonida. The pycnogonids are a relatively small assemblage of strictly marine animals with pincher-like mouthparts and four pairs of walking legs (a few species have five pairs and one particular species has six).

Sea spiders are generally quite small. Most species are usually no larger than 25mm (1 inch) in diameter including the legs, but one deep water species has legs that are nearly 70cm (28 inches) in length.

Pycnogonids are common intertidal animals, but most of the species, of which there are approximately 500, occur subtidally. One noteworthy species, *Pycnogonum stearnsi*, a comparatively large specimen, is found in a variety of habitats such as on and among hydroid colonies, anemones, and scurrying about on empty, discarded barnacle shells.

P. stearnsi, like other members of the genus, feeds by sinking its proboscis into its host and extracting the host's bodily fluids. In fact, all pycnogonids feed in a similar manner, preying on an assortment of animals from cnidarians (hydroids, anemones, soft corals) to sponges as well as bryozoans and tunicates.

Sea spiders have their sex organs located in the joints of their legs. In some species, there is an additional pair of legs curled under the body. Attached to the extra pair of legs during breeding season are eggs. Oddly enough, at least to us humans, these are usually on the male, who carries the eggs until hatching. However, in a few select species, it is the female who possesses the egg-carrying legs.

When hatched, the larvae settle out and become internal parasites in a variety of cnidarians until they develop into adults.

Pycnogonids are a primitive and fascinating group of marine animals. Although small in size and quite often inconspicuous, their importance in the marine environment, as represented by their evolutionary tenacity, deserves attention and further inquiry by divers and marine biologists alike.

Author's note: For additional information about sea spiders consult **An introduction to the Biology of Marine Life** (Fourth Edition) by James L. Sumich.

Coral Reef Ecology

The Structure, Types, and Formation of Coral Reefs

Part 2

by Douglas Fenner, Ph.D.

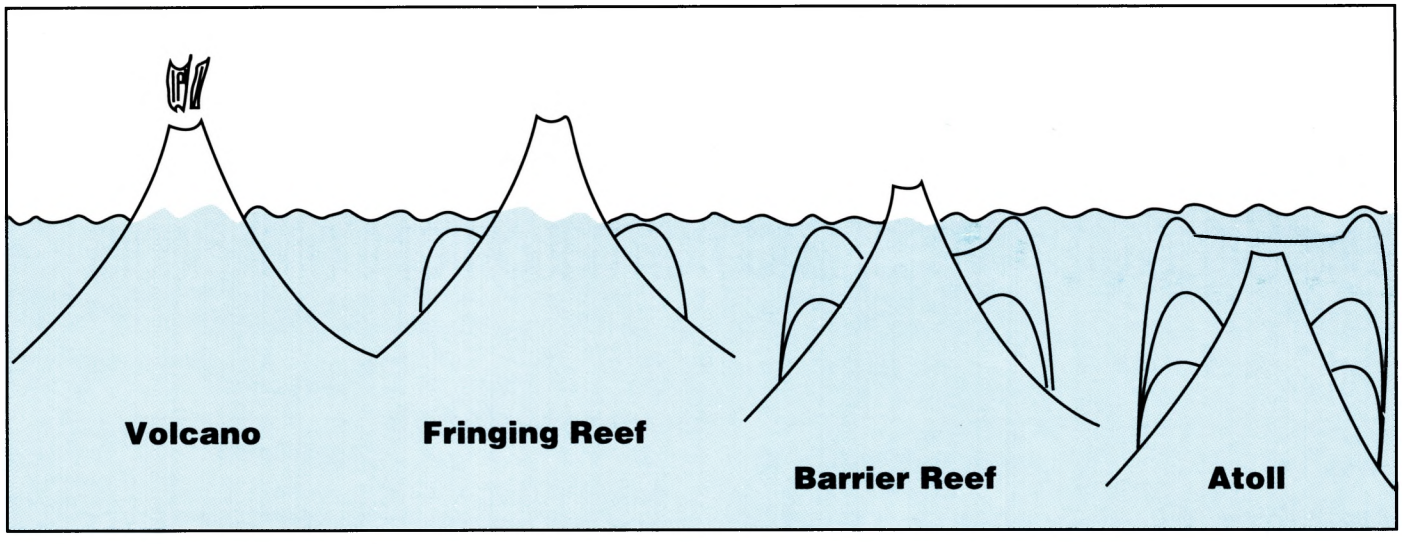
The first part of this series presented an overview of coral reefs, their location and growth. We will continue now with the structure of coral reefs; the different types of coral reefs, how they are formed, and the different zones within a reef.

There are many different sizes and shapes of coral reefs. There are four shapes of coral reefs that have names which are in common use. I should warn you there are lots of odd shapes that defy classification, including intermediate types between the four which I am going to give you. The four commonly recognized types of reefs are the fringing reef, the barrier reef, the atoll, and the patch reef. A fringing reef is found along a shoreline, snug up against the shore, like a fringe along the edge of a jacket, as the diagram shows on page 54. A barrier reef also parallels a shore, but is at some distance from the shore. There is an area between the reef and the shore called a lagoon. The barrier reef may come up close enough to the water surface to provide a barrier to navigation, and that's why it's called a barrier reef. The third type is an atoll. An atoll is an irregular ring of coral out in the ocean with no land mass in sight. The area inside the ring is also called a lagoon. The last type is a patch reef. A patch reef is a small patch of coral, ranging from the size of a city block down to the size of a small room. They are usually found in the lagoon of a barrier reef or an atoll. Even smaller patches of coral are often called coral heads. The ring of coral such as is seen in an atoll is a very stable and common form. Patch reefs sometimes have such a ring shape, and in Australia these are called "bommies". A small coral head in shallow water may die where it is exposed to air in the center, and continue to grow in a ring of live coral called a "microatoll". A very large barrier reef, such as the Great Barrier Reef, may have sections that become ovals, with a small lagoon in the center of each oval, in addition to the large lagoon between the reef and the shore. So the ring shape is found in a variety of different situations.

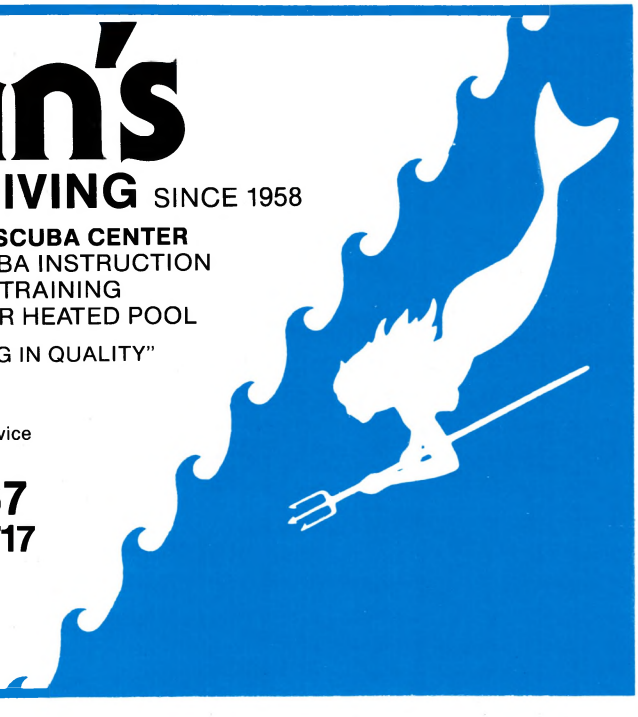
The distinction between a fringing reef and a barrier reef is difficult to define. A fringing reef as I defined it has no lagoon, and a barrier reef has a wide lagoon. Some scientists define a fringing reef as having only a small lagoon. In practice, reefs come with many intermediate width lagoons. Some reefs are against the shore along part of their length, and then have a lagoon of varying width along the rest of their length. The point is that the distinction between a fringing and barrier reef is somewhat arbitrary, and the same reef can be called either by different people.

Darwin's Theory

Charles Darwin proposed that the different types of coral reefs were related. He proposed that coral reefs evolved from fringing reefs to barrier reefs to atolls, and he made this proposal before he proposed his theory of the evolution of species. It's a theory which he based on very limited observations, and yet it is still held today, over 140 years later. Darwin observed coral reefs during his voyage on the *Beagle*, when it stopped at an atoll in the Indian Ocean after leaving the Galapagos Islands. The only way he could directly observe the reef was to walk on the exposed reef during low tide. In addition, the *Beagle* could be positioned over deeper parts of the reef, and a rope lowered to gather additional observations. A lead weight was tied to the end of the rope, with wax on its bottom. The weight would be lowered to the bottom, the depth measured on the rope, and then the weight raised onto the boat and the wax inspected. The wax would retain an imprint of the bottom, and sometimes bring up loose items stuck in it. When he got back to England, he went over his notes and read all he could about coral reefs, and then wrote a book to explain his theory. Without snorkeling, diving, submarines, cameras, or any other equipment, he put together a theory that has lasted over 140 years - not bad!

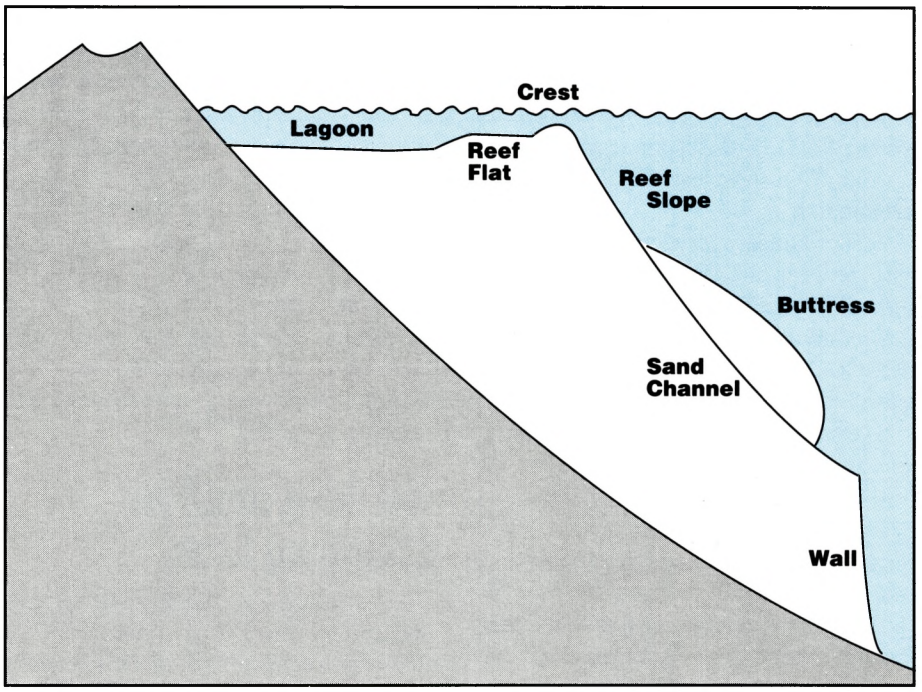


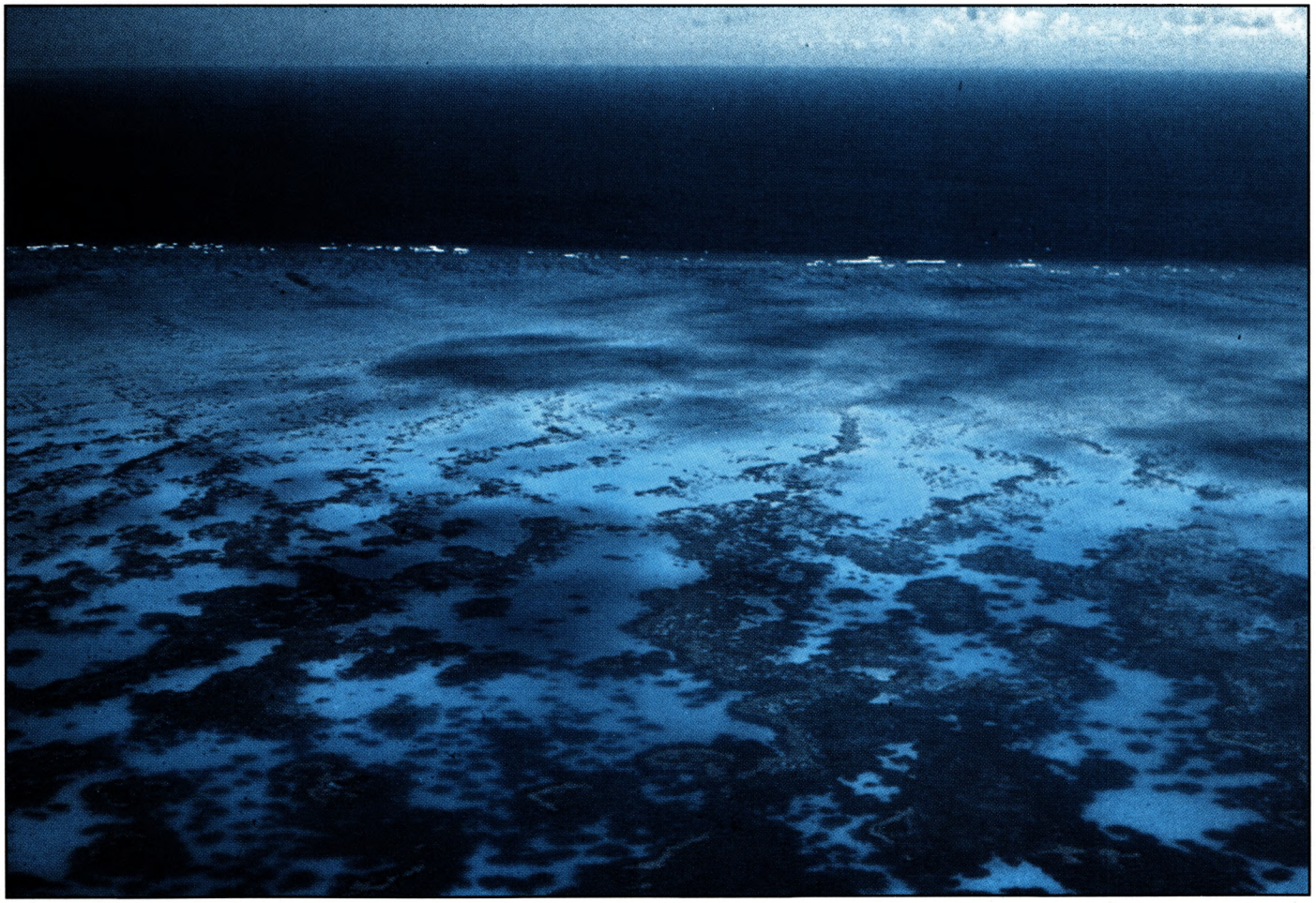
Darwin proposed that a volcano might erupt on the ocean floor and build up above the water's surface, as shown on the left in the diagram above. A fringing reef might then grow on the side of the extinct volcano, which then might slowly subside or sink under its own tremendous weight. The reef would begin as a fringing reef because corals grow most rapidly in shallow water. As the volcano sank, the reef would grow straight upward. The volcano probably sinks slowly enough so the reef can grow up as fast as the volcano sinks. As more of the volcano sinks beneath the water, a gap appears between the reef and the volcano. The reef is then called a barrier reef and the gap is called a lagoon. Finally the volcano sinks completely out of sight in the center of a ring of coral which has grown up where the original coastline of the volcano was. That ring of coral is called an atoll, as shown on the right of the diagram. This proposal was made at a time at which the movement of land masses was not yet recognized. Darwin felt that was not an unreasonable thing to suggest, because of what he had found in South America. In South America, he found fossils of marine organisms embedded in rock high in the Andes Mountains. He reasoned that the only way they could have gotten there was for them to have lived and died in the ocean, and fallen into marine sediments which were compressed into rock, and then lifted high into the mountains by the uplifting of large masses of rock. He reasoned that if masses of rock could be lifted, they could also sink. If the volcano had sunk, then the reef could have evolved from fringing reefs to atolls as described.



Alternative Theories

Alternatives to Darwin's theory of the evolution of coral reefs have been proposed from time to time. One proposal was that volcanos erupt until they approach the surface of the water. Sediments then build up on the top of the volcano until the water is shallow enough for coral to grow. The problem with that is that corals can't attach and grow on silt since they require a hard bottom. A second proposal was that an atoll is formed by coral growing on the rim of a crater on the top of a volcano. One problem with this is that volcanos would have to stop erupting just when they are within a couple hundred feet of the water surface. Another problem is that atolls are often much larger that the craters of oceanic volcanos. The largest crater of an oceanic volcano is on Maui, Hawaii, and covers fourteen square miles. Atolls range





in size up to 400 square miles. Truk is an atoll in the Western Pacific which was large enough for over 100 Japanese ships to be anchored when sunk by the U.S. in World War II. Truk lagoon is so large that several of the Japanese ships have never been found!

The evidence needed to decide for sure between the three theories of atoll formation I have presented here is to drill down through an atoll to find what is beneath it. Although Darwin knew that this was the way to test his theory, it was over 100 years before the technology and money was available to do the drilling. The first tests were made on Bikini and Eniwetok islands in the Pacific where the U.S. conducted many tests of atomic bombs, and money was available to find out where the radioactivity had gone. It was found that the coral rock on Eniwetok was about 3/4 mile deep, and was sitting directly on volcanic rock. The deepest coral rock was about 65 million years old, so the building of an atoll is a very slow process indeed. Clearly the coral could not have begun growing a reef upward from 3/4 mile deep, since we know that reef-building corals can't grow below about 300 feet deep. Indeed, the clincher for Darwin's theory was the fossils of land animals and plants found near the bottom of the coral. The only way that layer could have been exposed to air was for the volcano to have sunk; there is no way that the oceans were 3/4 mile shallower 65 million years ago than they are today.

Ice Ages and The Changing Seas

To explain some features of coral reefs one must add to Darwin's theory a consideration of the effects of changing sea levels produced by ice ages. Thirteen thousand years ago when the last ice age occurred, part of the earth's water was bound up in ice caps on North America and northern Europe and Asia. Ice that is floating in the ocean will not change the level of the ocean, but water locked up in ice out on land will lower the ocean level. Thirteen thousand years ago the sea level was lowered about 300 feet. If you think about it for a minute, that means that all presently living coral reefs were exposed to air and killed during the last ice age. However, individual corals could start growing at lower levels that were still covered by water at that time. But those corals are now covered by so much water that they have now been killed by the lack of light. Because the ocean surface has fluctuated up and down with repeated ice ages, it is possible to find the remains of reefs both above and below the presently living reefs. In the last million years or so, ice ages were almost continually coming and going, so the water levels were almost always going

up or down. Individual reefs are always being covered with too much water or left high and dry, with relatively short periods with favorable growing conditions in between.

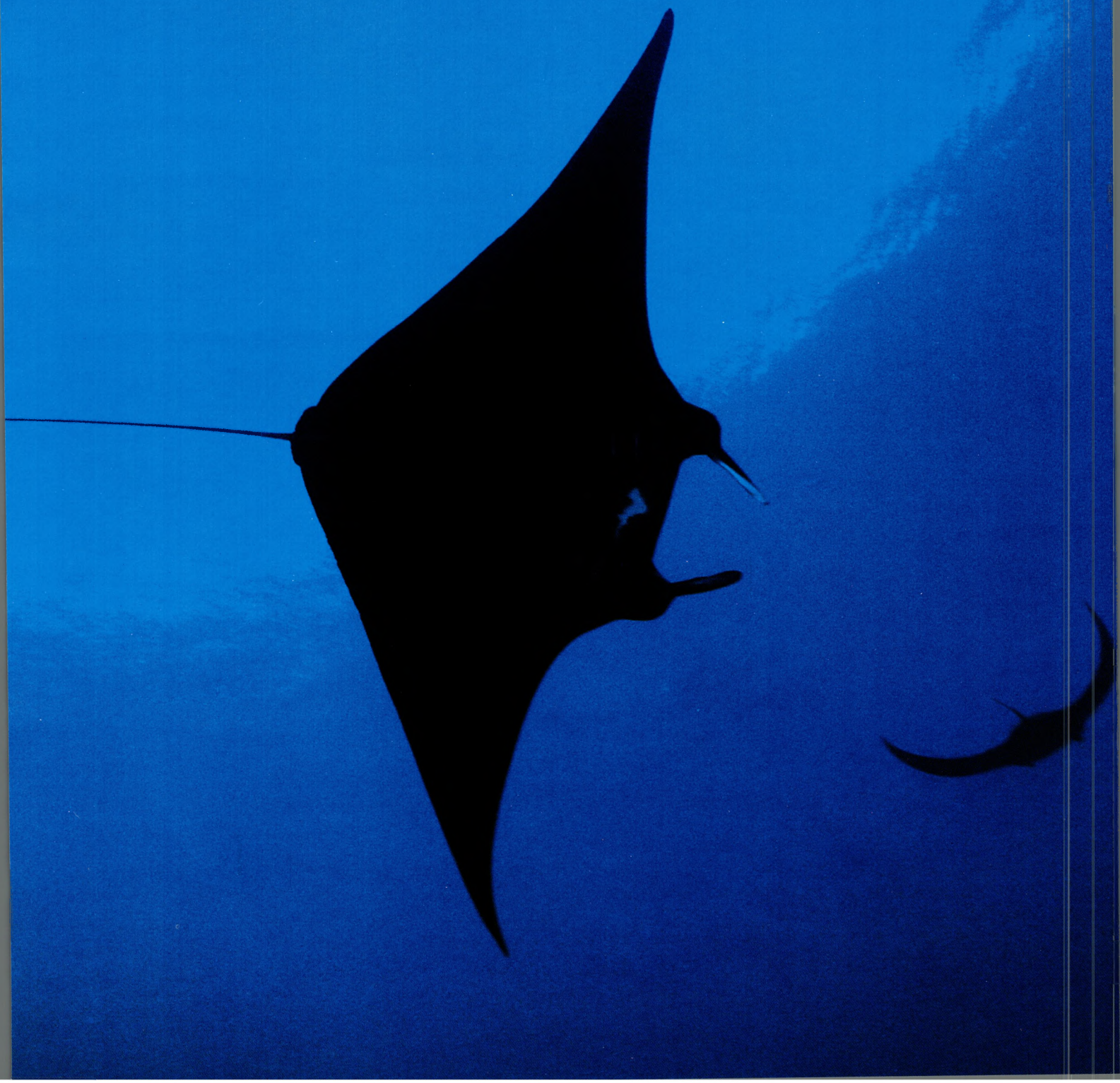
The ice ages probably also affected the number of species that live in different areas. In particular, the whole Caribbean basin north of the equator is much smaller than the Pacific. So the temperatures may have been significantly reduced in the Caribbean during the last ice age. Those corals that were more sensitive to cold may have died out, leaving just the hardier species to survive. The Western Pacific has a large area right on the equator where the water may have remained warm enough for most corals to survive. And that may be why the Caribbean has fewer species of corals and other organisms than the Pacific.

The Ever-Changing Reef

It is easy to think of reefs as stable ecosystems that have been slowly growing for millions of years much as they do today. But we are beginning to realize that reefs actually are constantly changing, and subject to frequent disasters. Continents slide across the globe, killing corals by cutting off warm currents or opening passages so one species can invade another's territory and wipe it out. Ocean levels continually change drowning the reefs or leaving them high and dry. The earth cools in an ice age, killing corals outside a few small refuges of warmth. Hurricanes hit reefs on the average of about ten times in 100 years, breaking corals or even creating total devastation that may require up to a hundred years for recovery. El Niño events heat the ocean killing all the corals adapted to cool areas of the ocean. Crown-of-thorns starfish arrive by the millions, eating all the coral in sight. A disease sweeps through an ocean, killing off 98% of the urchins on a reef in just two days. Populations of many animals are constantly increasing or decreasing. All of which gives us a very different view of coral reefs - as dynamic, changing ecosystems that are continually undergoing change. Change may be the rule, not the exception in coral reefs.

Sea of Cortez

PART FIVE



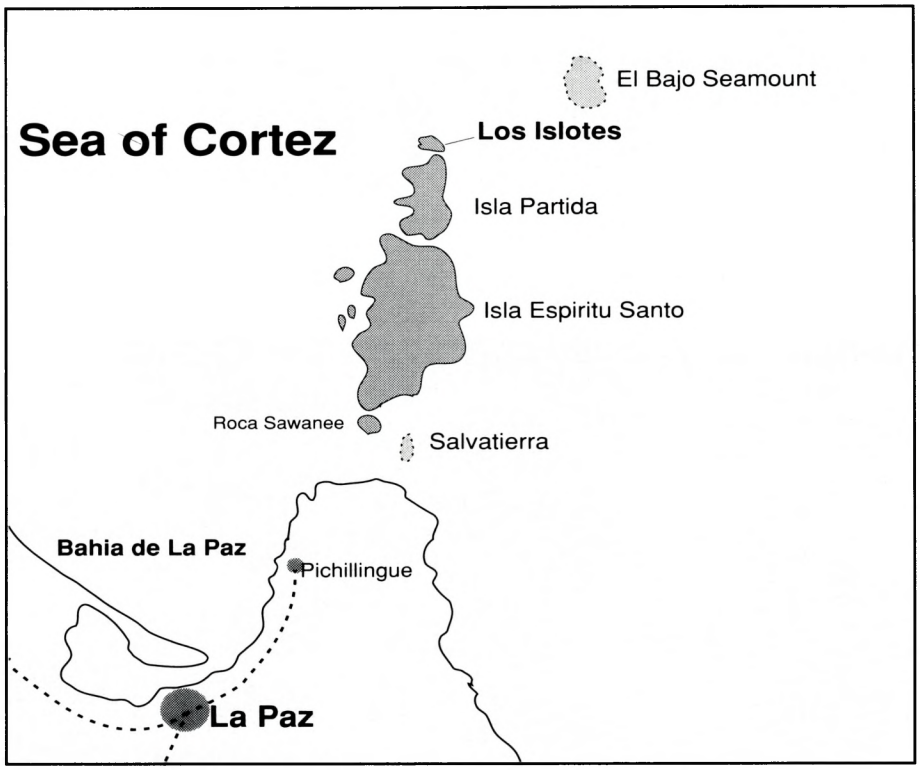
El Bajo Seamount

Text and photography by Al Bruton

In this issue of ***Discover Diving*** we conclude our series of dive sites in the Sea of Cortez. The sites featured (the wreck of the *Salvatierra*, Los Islotes, Isla Las Animas, and Isla San Diego) are some of the finest dive locations found in this beautiful ocean. Reachable only by dive vessels operating out of La Paz, these sites represent only a small fraction of the dive sites in the Sea of Cortez.

The Baja mainland is almost one thousand miles long and the Sea of Cortez borders over 80% of the eastern shoreline. Thousands of dive sites can be reached from shore and by small vessels that can easily be launched from beach camp sites and small boat launch ramps. There are several small dive shops operating out of Mulege, Lorreto , Cabo San Lucas as well as La Paz, and all of these shops offer full and half day dive packages. With all of this area to dive plus the many off-shore islands, there are many excellent dive sites yet to be discovered. We conclude this series with a look at what is the most famous and documented site in these waters, the seamount known as **El Bajo**.

The seamount is located twenty miles north of La Paz Harbor and eight miles east of Esperito Santo Island. In open ocean waters, El Bajo is the top of an underwater mountain range that reaches to within 65 feet of the surface at its highest point. The entire area of the peak is about 1/2 mile long and 1/4 mile wide in an oblong shape. The seamount presents itself as a series of ridges whose walls drop to sand channels at 110 to 130 feet. The outside edges of the seamount drop into water of incredible depths.



The El Bajo seamount has been featured in such films as **El Bajo**, **The Devilfish of El Bajo**, **Secrets of the Sea**, and three episodes of ABC's **American Sportsman**. Almost any film you see on the underwater life of the Sea of Cortez will contain footage shot at this location.

The seamount was first discovered by Mexican fisherman and named the Merisla Seamount. The first person to dive and document the seamount was Richard Adcock. It is now a regular stop for most of the dive vessels operating out of La Paz, including the *Don Jose*.

What makes this site so special is its direct proximity to the deep waters of the Sea of Cortez, thus the food chain is extensive from the bottom to the top. The large pelagic species that made the Sea of Cortez famous are most likely to be encountered at this site and many species of marine life are abundant. The negative side is that your dives start at 65 feet and go deeper, thus reducing bottom time and number of dives possible.

In the July/August 1990 issue of ***Discover Diving*** I spoke of the schooling scalloped hammerhead sharks of **Las Animas**. The El Bajo is even more famous for these magnificent animals, but the same problems for divers exist. The sharks like colder water, therefore they are below the thermocline and below skin diving range. The bubbles of scuba tend to keep the sharks off in the distance. However, many divers spend too much bottom time looking for the sharks and fail to observe all the other marine life at El Bajo.

If you want to try for the sharks, two methods seem to work best. One is to swim a compass course of 290 degrees from the top of the mount. Sightings are often reported on this course, but your bottom time and air consumption make it a shorter dive. The alternative is to have the pongas (small Mexican fishing boats) drop you off upcurrent (there is usually a small current in the area) and drift back to the boat at a water depth of 80 to 100 feet, keeping the bottom just in sight. This is an open water dive and you will either see a lot, or nothing.

Other large animals that can be seen here are manta rays, large schools of jacks, anchovies, an occasional marlin (I saw four on one dive this year!), dolphins and occasionally a whale shark. If you see these creatures you are privileged. If you do not, don't feel bad. Most of the footage shown in films on the site required weeks to shoot and hundreds of dives. The site is still an excellent dive and worth the trip to it. You never know what might swim by.

If you like to observe, feed and photograph moray eels, you'll definitely find them at El Bajo. The eels are everywhere. Look in the crevices along the walls, holes on top of the mount and small caves, and you will find one and often two to a crevice. Large Cortez angels, parrotfish and snappers are also abundant, and this is one of the few sites in the Sea of Cortez that you can find the rare chocolate chip starfish.

The seamount is close to **Los Islotes** which means that sea lions are usually in the area feeding. They tend to be the younger bulls and females and they are quite friendly. Often they will swim with the divers or rest next to or under the boat. Last year I had an encounter that provided me with some of

the finest images I've ever taken of these beautiful animals.

A young female sea lion stayed just under the *Don Jose* and allowed us to swim to within one foot and photograph her. She would even allow us to pet her belly and head. I was able to take full frame shots of her head that are so clear it is difficult to tell that the photographs were shot underwater. She stayed under the boat for over one hour, surfacing occassionally for air then returned to share time with us. I shot two full rolls of film of her, and other photographers on board did the same. She even followed one diver to the bottom and visited others on decompression stops. Encounters such as this can be common at El Bajo.

Diving at El Bajo provides a different feeling than the other sites found in the Sea of Cortez. There is no land in close proximity, no reef reaching to the surface, and you get the full impact of diving out in the open ocean waters. You find yourself constantly looking around to see what will swim by, not due to fear, but rather anticipation and hope of having an encounter with an animal that will remain indelibly marked in your memory for life. It may not happen, but if it does I hope you have a camera in your hands so you can share with your friends the excitement that **El Bajo** can provide.

As a final footnote to this series I must warn you that once you have dived the Sea of Cortez, you will become exposed to a serious disease. It is known as *The Baja Blues*. You will suffer from strong desires to get away from your daily routine, feel depression with lots of daydreaming, have an inability to work as well as a need to shed your clothing till nothing remains but your bathing suit. You will also suffer from strong cravings for any or all of the following refreshments: Rum & Coke, Pina Coladas and Mexican beers such as Corona, Dos XX's, Bohemia and Carta Blanca. Temporary relief from the Baja disease is available by contacting your travel agent, or by calling **Baja Expeditions** at (619) 581-3311. They can make all arrangements for a quick and painless cure.

Octopus

*This diver discovered a small octopus on the wreck of the **Balboa** in Grand Cayman. If octopus are handled gently there is little risk of being bitten by most species, but this innocent looking species has been known to bite the hand that feeds or holds it.*

Text and photography by Marty Snyderman

The octopus crept ever so slowly across the sandy bottom as it closed to within striking distance of the tuna crab. Perfectly camouflaged to match the surrounding sand, the octopus paused before extending one coiled arm into the path of the oncoming crustacean. Then the octopus froze, remaining absolutely motionless, yet poised and ready to pounce on its unsuspecting prey. The hunter waited, remaining perfectly still, as the crab neared. Suddenly the predator pounced, uncoiling its deadly arm, the firm grip of its sucker-like discs deftly entangling the surprised victim.

Within a matter of seconds the crab was engulfed in the octopus' smothering arms, and once the victim was under control the octopus quickly stuffed the crab under its mantle where its sharp beak drilled through the crab's shell. The octopus sucked the meat out of the shell, and within seconds it was all over.

Then the octopus darted away, only to settle again a few feet away. Once again the octopus was almost within striking distance of an unsuspecting crab. Coiled arm

thrust forward toward the path of yet another victim, the octopus stopped moving, the predator patiently stalking its prey. A few seconds later it was all over for the second of five victims, all of which perished as a result of the predatory skill of one clever octopus, an animal so small that I could have easily placed it inside the pocket of my buoyancy compensator. Within a 10 minute time span I watched this tiny killer catch and devour five crabs as it roamed the bottom of the La Jolla Submarine Canyon off the San Diego beach known as The Shores. A master of stealth, cunning, and decisive action, the octopus displayed predatory skills so refined that not a single crab escaped. In fact, not a single crab ever had a chance to use its powerful pinching claws in its own defense. The element of surprise had served the hunter well.

The octopus that Bob Cranston and I observed that night is known to scientists as, *Octopus rubencens*. Although commonly seen by divers, especially in sandy areas in Southern California, this species has an arm span of less than one foot from arm tip to arm tip. *Rubencens* is only one of the more than 150 species of octopuses found in oceans around the world. (The words octopuses and octopi are both correct plural forms of the word octopus.) Octopuses, along with their close cousins the squids, cuttlefish, and nautiluses, have well-developed brains and are considered to be the most intelligent of all invertebrates. In fact, some scientists describe octopus behavior as ""near-mammalian."

Octopuses, squids, cuttlefish, and nautiluses make up one of the seven classes of mollusks called cephalopods (head-foot). The phylum of mollusks is the second largest animal phylum known to science with more than 110,000 described species. Only the phylum Arthropoda includes more species. In their basic body plan, mollusks possess three distinct features. They have distinct bilateral symmetry, a soft visceral body mass, and a muscular foot that is used in locomotion. Most mollusks such as snails have a hard outer shell. In some species, however, the shell or its remnants are internal, and in some species the shell is totally lacking. And all mollusks, except for bivalves such as scallops, have a unique rasping tongue. Mollusks such as nudibranchs use their radula to scrape algae off the substrate, while octopuses use their radula primarily to puncture prey and to extract food from prey victims.

This Clever Mollusk is One of The Most Fascinating, Yet Most Wary, Of All Sea Creatures

Octopuses lack an external shell, but their soft body parts are quite similar to hard shelled mollusks. In addition, their foot has been transformed into eight tentacles or arms of equal length. Each tentacle is equipped with one or two rows of suction cups commonly referred to as suckers. Many of the sensory organs of octopus are well developed and sophisticated. For example, their eyesight is excellent, and in many respects their visual systems are similar to those found in highly developed vertebrates. As far as divers are concerned, the well developed sense of sight means that if you see an octopus at the mouth of its den, it is usually best to keep some distance between yourself and the octopus if you hope to see the animal completely emerge. Sudden movements can frighten an octopus and they are quick to seek cover.

Their tactile sense (touch) is also well developed and extremely sensitive. Octopuses have tactile chemoreceptors on the end of each tentacle, and in effect, have eight noses as well as eight "hands or arms" with which they can explore their surroundings. So when an octopus extends a tentacle toward a diver, a discarded shell, a bottle, or any other object the animal is probably just trying to learn about its environment in the most efficient way it knows how.

Octopuses are also well known for their ability to produce ink which is used as a defensive mechanism to help avoid predators such as moray eels and fish. The ink is produced by special glands and can be discharged at will. The ink serves two purposes. One purpose is fairly obvious in that the ink serves as a "smoke screen" which helps the octopus evade a potential predator by obstructing the predator's vision. The second function is perhaps less obvious, but equally important. The ink serves as an anesthetic which dulls the olfactory senses of predators such as eels. For humans, it can be difficult to imagine that any animal could hunt primarily by their sense of smell in water. But it is well documented that moray eels, among other predators, rely heavily upon their olfactory capabilities when in pursuit of prey. In fact, morays have comparatively poor eyesight. The ink ejected by an octopus dulls an eel's sense of smell and greatly assists the octopus in its effort to escape. But you can rest assured, if the eel recognizes an opportunity and acts quickly, it will devour an octopus in short order.

To most non-experts, octopuses are best known for two reasons. One, they are often depicted as submarine eating sea monsters in "B" grade movies, and two, they are known as masters of camouflage. Normally the coloration of an octopus closely matches the color of its immediate surroundings, but when disturbed or excited, octopuses can change their colora-

Bottom dwelling octopus usually make their home in some kind of crevice called a den. In this photograph taken at the Coronado Islands off San Diego, an octopus has taken up residency in a discarded shell. Note the Octopus using a small shell as a means of helping to block the entrance to its home.

tion, shape, and the texture of their skin in dramatic fashion. An octopus can be dark brown and smooth one minute, cherry red and ruffled the next, a mottled blue and white only a moment later, and white and smooth before you have time to take a photograph. The range of possibilities seems limitless, as the different modes are suspected in some instances to indicate a variety of emotions such as anger, fear, and frustration etc. However, some scientists question whether the link between color changes and supposed mood changes has ever been verified.

By varying the blood flow to light altering cells in their skin called chromatophores, an octopus can vary its color, while muscular contractions assist the changes in texture. When changing color, octopuses do not emit light. Instead, they expand or contract chromatophores which alters the shape of pigment granules that are found within the chromatophores. The change in the granules causes a change in coloration.

The unique ability to change color and shape so rapidly allows octopi to be superb camouflage artists. As a general rule, octopuses, like flatfish, direct their short-term color changes toward matching the brightness and contrast of their backgrounds, but over longer time spans they will match the specific colors of their immediate surroundings.

On many occasions while filming an octopus that was out in the open away from cover, I have lost the animal. And on more than one embarrassing moment, my diving buddy has calmly stopped me and pointed the octopus out to me just as I was starting to swim away being sure that the octopus had slipped into some crevice that I could not find.

Two species of octopuses bear special mention. They are the giant Pacific octopus, *Octopus dofleini*, and the venomous blue-ringed octopus, *Octopus maculosus*, that is found in the waters of south Australia. Primarily responsible for all octopuses' reputations as sea monsters, giant Pacific octopuses have been documented to attain a size of 22 feet from arm tip to arm tip according to Dr. Jim Cosgrove, the Chief of Biological Collections at the Royal British Columbia Museum. Cosgrove adds that an animal that size will weigh approximately 600 pounds. Giant Pacific octopuses are often seen in temperate waters along the Pacific coasts of northern California, Oregon, Washington, and Canada. Specimens that weigh 20 to 50 pounds are commonly encountered, and it is not all that unusual for those people who dive these areas on a regular basis to encounter specimens that weigh in excess of 100 pounds. Despite their size, giant octopuses usually live to be only 3 to 6 years old.

But size alone does not make an octopus or any other sea creature a monster. Quite the contrary in the case of giant Pacific octopuses - these supposed villains of the deep are usually quite shy and rather wary of divers.

Giant Pacific octopi prefer to live in dens that are usually several feet in diameter and have a minimum of two openings.

Giant Pacific octopus have been documented to reach a size of 22 feet across from arm tip to arm tip, and at such a size, they weigh close to 600 pounds. Despite their size they are shy and retiring creatures, who when handled are usually quite gentle.

At first glance, the melon-sized openings appear rather small for such large animals. However, because octopuses lack bones, they can alter their shape and crawl through tiny spaces. On more than one occasion, I have been amazed to see a 40 to 50 pound specimen easily pass through a softball-sized space.

The dens are usually very easy to find because giant Pacific octopi are voracious eaters, preying heavily upon clams and crabs. After capturing their victims, these octopuses usually return to their dens before devouring their prey. The octopuses eat the meat and discard the shells which they pile up outside of the den. The pile is known as a midden heap. If an octopus who has occupied a given den for a few weeks, the midden heap is likely to be at least six feet across with shells piled up so densely that you cannot see the sea floor through the pile.

Although they will eat during the day if the opportunity presents itself, giant Pacific octopi are primarily nocturnal predators. The same is true for most species of octopi. It is also quite common to find a midden heap outside of the dens of many other species of bottom dwelling octopi, as most species prey heavily upon crabs, clams, lobster, snails, and other shelled animals.

Octopi cannot afford to range far from their food sources. Once they eat, they must process that food and eliminate waste before they eat again. That is because the opening to an octopus' stomach also serves as the opening to the anus. In addition, octopi use a lot of energy when they respire and they require a large amount of food to maintain their strength and energy level. As a result, scientists point out that octopi

are greatly limited in their range and in the size that each species can attain.

In non-documentary films and novels, giant Pacific octopuses are often depicted as sea monsters that willingly attack divers. While "willingly attack" is a long way from the truth, many underwater photographers enjoy taking pictures of divers "wrestling," or at least handling these creatures. I plead guilty as charged. The photographs look dramatic, and as long as the animal is not harmed, it seems like a justifiable experience. However, one should keep in mind that it is best to be gentle with octopi as they are easily injured. Their bodies are very soft and when they wrap a tentacle around you or your mask, it is easy to tear the tentacle in a moment of excitement.

Once they are out in the open an octopus tends to tire very easily. Even though their gills are very efficient and octopi can extract close to 50% of the oxygen in the water that passes over their gills, they use up to 98% of the oxygen they respire every time they breathe. This means that there is not much of a reserve left to fall back on when energy demands from the body are high. So the animals tire very quickly and generally put up only limited resistance when being handled.

At times, giant Pacific octopuses have been known to grab a mask off of a diver and to forcibly pull on a regulator. Obviously if the animal feels threatened it will tug and pull on anything it can get hold of, and several species have been known to bite divers. However, normally if the diver is very gentle, the octopus will follow suit. In fact, once they are out of their den, their natural curiosity often overcomes the larger specimens, which readily approach divers. If you are ever so fortunate, remember to move slowly and to be gentle.

Octopuses are excellent swimmers. An octopus gains its thrust by rapidly expelling water from a small tube called a funnel or siphon that is located at the base of the comparatively large mantle. The funnel is a modification of the foot. Octopuses can point their funnel in any direction and, thus, have superb body control. As an octopus breathes, water is sucked into the mantle and passes over the gills. The water is then forced out through the funnel and the animal "jet-propels" itself backward (at least from the direction the funnel is pointed) through the water.

When swimming, octopuses often flatten and extend their bodies into the shape of a thin wing. Scientists refer to the act as forming a wing and Dr. Cosgrove is quick to point out that while most people associate wings with aueronautical science, a wing is a very effective form which helps marine animals "fly" through water by creating lift.

As is so often the case with Hollywood where giant octopus and squid serve as fodder for horror films, the real life versions of venomous mollusks tend to be very shy and retiring creatures. The well

publicized blue-ringed octopus of Australia, whose bite can be fatal to small children or adults bitten in vulnerable spots, is a classic case in point. If roughly handled they are quick to bite, but they usually only bite when provoked. Like other species of octopi, the small blue-ringed octopus (typically about the size of your hand) uses its birdlike beak to inject a fast acting nuerotoxin directly into its victim through the wound caused by its beak. In some other species the nuerotoxin is discharged into the water in an effort to stun or kill prey.

On many occasions I have watched night divers gently handle the common Caribbean octopus, *Octopus briareus*, without suffering any harm. However, about two years ago a very experienced Caribbean divemaster was bitten in the hand by this species. According to her account which was verified by several witnesses she had the octopus on top of one hand, was applying no pressure, and her other hand was resting on her knee. The octopus had been sitting on her hand for several minutes and did not appear to be disturbed or stressed when it suddenly bit her.

The bite was painful, but was thoroughly cleaned out. The next day there appeared to be no problem with the bite area, but several nights later her hand and entire arm suddenly became dangerously swollen. She was taken to a Miami hospital where it was eventually determined that the tiny octopus had bitten into the bone in her hand. My friend suffered from a nasty bone infection for almost five months. I am not saying that octopuses readily attack divers, but I do want to point out that they are wild animals and will do what they chose when they chose.

The sex life of octopi is rather interesting. In some species the male places sperm on a modified tentacle which is then offered to the female. When the female accepts his offer, she takes both the sperm packet and most of the male's tentacle as well. The male is capable of regenerating his lost arm. The female usually lays the eggs in berry-like strands inside of her den where she guards them for several months until the eggs hatch. (Obviously not the case with open water, pelagic species.) While the female guards the eggs, she does not leave the den to hunt and she loses considerable size because she does not eat. In the case of the giant Pacific octopus, the female will lose approximately 80% of her body weight over the 6 to 8 months that she guards her eggs. Shortly after the eggs hatch, the female dies.

Octopi are a popular food source for man, especially in many Third World nations and in the Far East. And even here in North America commercial fishermen pursue giant Pacific octopus along the southwest coast of Canada.

Octopi are indeed clever and fascinating mollusks. Their somewhat suspicious yet curious nature can provide a diver with a bounty of education and entertainment.

DIVE COMPUTERS IN HIGH ALTITUDE DIVING

By Danny Rossi

Diving at higher elevations implies diving with reduced atmospheric pressure at the surface. Because of this, several considerations need to be taken into account with respect to the use of dive tables or dive computers at altitude.

First, as the diver travels to the high altitude dive site from a lower elevation, there will be a certain amount of excess nitrogen pressure in the tissues (with respect to the lower ambient partial pressure). This is the same as saying that there will be "residual nitrogen" in the divers body. Therefore there will be a "desaturation or adaptation time" before the first dive can be considered non-repetitive, otherwise this residual nitrogen has to be taken into account in the dive planning.

Second, the reduced atmospheric pressure at the surface will translate into shorter No-Stop times for the different depths, with corresponding reductions also on the ascent rates and equivalent safety stop depths.

Finally, instrumentation errors may need to be taken into account, as many depth gauges are designed and calibrated to read zero feet on the surface at sea level, with no provisions for corrections for altitude use.

Using Dive Computers at High Altitude

When considering using a dive computer for high altitude diving (within its specified range), there are three categories to consider:

A) the dive computer fully compensates for altitude by indicating the correct depth and the reduced No-Stop times, while also calculating and taking into account the "adaptation time";

B) the dive computer compensates for altitude by indicating the correct depth and reduced No-Stop times, but with the assumption that the diver has fully "adapted" to the new altitude prior to the first dive (i.e. no "residual nitrogen" in the divers body);

C) the dive computer compensates for the altitude by indicating the correct depth and time only, with all the other decompression requirements to be calculated by the diver using a suitable dive table.

The first place to look for information about a dive computers' high altitude capabilities is, of course, the user's manual. The manufacture will usually include at least a statement of the altitude limitations, but in many cases a lot more information will be provided. The information provided may be sufficient to identify if a particular dive computer falls into any of the three categories identified above.

Diving in 40 lakes of California, from Shaver Lake at 5,500 feet to Saddlebag at an altitude of just over 10,000 feet, confirmed the indicated performance on some dive computers and also showed some interesting surprises. The test dives ranged in time from 21 to 92 minutes with depths from 12 to 160 feet.

Note: Depth indications were compared against a temperature-compensation digital instrument with an altitude range of up to 14,800 feet. Its depth calibration was checked against true depth measured by an inelastic line. The instrument read and indicated atmospheric pressure in millibars at power on. This indication was checked against a barometer at the different dive sites.

Beauchat Aladin and Aladin Pro; U.S. Divers Monitor I and Monitor II

Four different computers, the Aladin, Aladin Pro and the Monitor I and II fall into category A above. The Aladin does require to be switched "on" prior to the first dive, but the other three computers are

always ready to be taken diving provided that no altitude change has occurred within the last 35 minutes.

As expected, these four dive computers performed very well, as our diving was within their specified altitude range (13,200 feet). On some occasions, the Aladin computer would not readily "sense" (with its on/off switch) the fresh water, requiring a cleaning of the contacts to turn it on. When the computer did not properly detect the fresh water, errors in selecting the altitude range were occasionally observed.

The available No-Stop times indicated by these dive computers would get longer as we allowed more surface time prior to our dive, as "adaptation time" ticked away. The only exception to these was the Aladin, which needed to be switched "on" within ten minutes prior to the first dive, therefore the computer always assumed that the diver had just arrived at that altitude. (No credit being given for time spent at altitude before the first dive).

After the dives, in many cases there was not an indication of Time to Fly on the Aladin Pro and the Monitor II; for example after diving in lakes at 9,600 feet. Also, travelling to lower elevations after the diving, the desaturation time indicated by these two computers would diminish by more than the time elapsed. In many cases, when travelling to a lower elevation zone, the computers would indicate that it was no longer in a repetitive dive mode, by switching off, indicating complete desaturation to the new elevation.

Dacor Micro Brain and Micro Brain Pro Plus Dive

Two dive computers, the Micro Brain and the Micro Brain Pro Plus, fall into category B. With these two dive computers, no adaptation time is required up to 4,920 feet. Beyond this level and up to 6,560 feet the adaptation time will depend upon your starting elevation. At altitudes higher than 6560 feet, the depth indication will remain correct up to 19,685 feet for the Micro Brain and up to 14,764 for the Micro Brain Pro Plus.

The user's manuals for these two dive computers provide all the necessary information regarding the times the divers must wait, at altitude, before diving. (This is so that No-Stop times indicated by the computers are valid).

The No-Stop times given by these two computers are the same at altitude as at sea level. The fact that these No-Stop times have been adjusted for diving up to 4,920 feet with no corrections gives an indication of the extra safety margin that these two computers provide when diving at sea level.

These two dive computers performed well, once I could get them switched to the dive mode. Almost always I had some trouble getting the computers to activate once in the (fresh) water, the problem being worse after a series of dives in the ocean and then doing fresh water dives. The solution I found to this inconvenience was to always clean the contacts prior to my first fresh water dive, Using an eraser. The gold contacts on the Micro Brain Pro are a definite improvement, but the cleaning was still required.

Comparison of Dive Computers in High Altitude

DIVE COMPUTER	ALTITUDE RANGE (FEET)			Dive Time	Depth	Max Depth	No-Stop Time	Adapt. Time	Ascent Time
	Full Compensation	No-Stop Times Compensation	Depth Compensation						
Beuchat Aladin	13,200	13,200	13,200	YES	YES	YES	YES	NO	NO
Beuchat Aladin Pro	13,200	13,200	13,200	YES	YES	YES	YES	YES	YES
U.S. Divers Monitor I	13,200	13,200	13,200	YES	YES	YES	YES	NO	NO
U.S. Divers Monitor II	13,200	13,200	13,200	YES	YES	YES	YES	YES	YES
Dacor Micro Brain	4,920	6,560	19,685	YES	YES	LOG	YES	NO	NO
Dacor Micro Brain Pro Plus	4,920	6,560	14,764	YES	YES	LOG	YES	NO	YES
Oceanic Datamaster II	2,000	2,000	9,900	YES	YES	LOG	NO	NO	NO
Oceanic Datamaster Sport	2,000	2,000	9,900	YES	YES	LOG	NO	NO	NO
Oceanic Datamax Sport	3,000	3,000	10,000	YES	YES	NO	NO	NO	NO
U.S. Divers Data Scan 3	2,000	2,000	9,900	YES	YES	LOG	NO	NO	NO
Suunto SME-ML	1,600	1,600	7,000	YES	YES	YES/LOG	NO	NO	NO
Orca Edge	2,000	2,000	12,000	YES	YES	YES/LOG	NO	NO	NO
Orca SkinnyDipper Mark II	2,000	2,000	18,000	YES	YES	LOG	NO	NO	NO

Oceanic Datamaster II, Datamaster Sport and DataMax Sport; U.S. Divers Data Scan 3

All of these dive computers fall into category C above. They need to be switched "on" once the diver is at the dive site, so that the computers would indicate the true depth, compensating for the high altitude. The computers now act as precision timer-depth gauge combinations, no longer providing any decompression information.

As the user's manuals indicate, all these dive computers performed well up to 10,000 feet of altitude, the depth indications being well within the specified tolerance of one percent. The computers are salt water calibrated, so that in fresh water the indicated depth will be slightly less than true depth.

An unexpected surprise was that the DataMax Sport had no maximum depth recorded in the log. After dives at altitude for dive times between 30 and 51 minutes and depths from 35 to 55 feet its log showed the correct dive times but a pair of flashing zeros for maximum depth for each dive.

One other shortcoming shared by all of these four computers concerns changing the dive site after the first dive. While the computer is still on, it does not measure again the atmospheric pressure. What this means is that, when travelling to a different (say lower) elevation lake, upon arrival, the computer would already be indicating a depth different than zero (two to three feet). In one case this caused the console-mounted computer to start counting dive time during the surface swim — the extra three or four feet of depth due to being at the end of the hose was sufficient to reach the seven feet activation depth of the dive timer.

In the case of the DataMax Sport, the four to five foot activation depth of the dive timer made this dive computer more prone to start timing a dive while still on the surface. In the worst case, which happened often when diving lakes higher than 8,000 feet, upon travelling to a dive site at a lower elevation the pressure difference would be sufficient to start the computer on the next dive — all by itself! — indicating five feet of depth. In one extreme case, a depth of eleven feet was indicated, when travelling back to sea level from a high altitude lake dive.

When this happens, the dive computers will continue on their own dive until the dive time exceeds the maximum of ten hours and after an additional period of time the computer will switch off.

While this is generally not a problem in most of real life lake diving, it does point to the need to not switch "on" your computer until the dive site has been reached.

Suunto SME ML

This dive computer falls into category C above. The user's manual indicates a maximum operational range 1,600 feet above sea level. It needs to be switch "on" once the diver is at the dive site, so that the computer would indicate the true depth, compensating for the high altitude.

Surprisingly, the computer did compensate, indicating correct depths for altitudes up to 7,000 feet. Being calibrated in feet of sea water (instead of fresh water), the depth indications were always less than true depth, but well within the instruments' specified tolerance of +/-3.5 feet.

The computer will continue to provide No-Stop times even at this higher altitudes, but this information must be ignored, since the numbers would not be correct. Even the "Do Not Fly" indication would appear after a dive at 8,000 feet of altitude! But the nice thing is that is provides proper depth and dive times, together with the corresponding logbook functions.

The dive computer performed very well in fresh water, activating properly always. For the record, some error in the depth indication (about three to four feet shallower than true depth) started to show up at around 8,000 feet of altitude; and the indication was definitely out of tolerance at 9,000 feet (more than five feet of error).

Orca Industries Edge and SkinnyDipper Mark II

These two dive computers also fall into category C above. The user's manual indicates altitude limits for the decompression algorithm of 2,000 feet. But as a precision depth gauge and timer, the edge will work up to around 12,000 feet, while the Mark II will indicate correct depths even at altitudes as high as 18,000 feet.

The computers will continue to provide No-Stop times even at these higher altitudes, but this information must be ignored, since the numbers would not be correct. But the nice thing is that it provides proper depth and dive times, together with the corresponding logbook functions. Ocra Industries suggests using the depth and time indications provided by the dive computers with the E.R. Cross corrections to the U.S. Navy tables.

Both the Edge and the Mark II performed very well at altitude with accurate depth indication (salt water depth calibration). For high altitude diving, the manual "on/off" switch that these dive computers have now becomes a very useful asset. It allows them to be switch off and re-initialized in the case of travelling to a different elevation lake site. In this way, an accurate surface reference pressure can always be obtained, despite the fact that the computers do no measure the atmospheric pressure again as long as they are still "on". The loss of residual nitrogen information is no longer a factor, since the decompression algorithm is limited to 2,000 feet and the computer is now being used as a precision depth gauge and timer only.

Conclusions

The results of extensive testing of currently available dive computers performance in high altitude diving has been presented. This information should help the diver assess how a particular model would suit his/her needs.

Even if you currently own a dive computer whose algorithm does not compensate for altitude diving, do no leave it in your dive bag when you go diving in a mountain lake. Most likely it would still give you correct depth and dive time information. Just make sure that you do switch it "on" at the dive site prior to entering the water, to be able to get accurate depth indications.

Outboard Jack

The sea offers many challenges. Some are better left unmet.

A fictional story by Carlos Eyles

I remember the first time I saw him. I was fishing in my usual place on the pier and he came walking up the steep, dingy ramp with a 25-horse outboard slung over his shoulder. I never saw anyone carry a big outboard that way, and figured he was about the strongest man I'd ever seen. He was probably heading for my dad's outboard shop, the only one on the island. I reeled in my line, and ran like crazy around the mooring storage and the island store. I got to the back door of Dad's shop as he was coming through the front.

He gave Dad respect because he too was a free diver. I mean, not nearly as good as him, but it didn't matter, he treated Dad as an equal, and they got along fine.

My dad isn't exactly small, but standing next to this fellow, he looked shorter than I'd ever seen him. This guy was at least a foot taller, and he had a big, old beard and his hair was all mussed up, and he smiled a lot. He had real blue eyes, and they smiled more than his mouth. He and my dad got to talking, first about the motor, which had a busted water pump, then about the ocean. Dad always got around to talking about the ocean. He loved everything about it, and fished and dived it every chance he got. Dad knew all the good spots from one end of the island to the other. They kept on talking, and this fellow, his name was Jack, seemed to know every good fishing spot that my dad knew, and then some. He was a free diving spearfisherman, and you could tell he knew his way around the water. He gave Dad respect because he too was a free diver. I mean, not nearly as good as him, but it didn't matter, he treated Dad as an equal, and they got along fine.

One thing led to another, and Dad said that they were going to have this fish fry down at the beach tonight, and that he was welcome to come by. Problem was no one had come up with any fish, and it looked like it was going to be beans and a big salad, but it'd be fun anyway. Jack said "Well how much fish are you going to need?"

Dad said, "We're going to have about a dozen or more folks – some coming from Black Point, some coming from as far away as Hen Rock, maybe sixteen if everybody shows up."

"If you loan me one of your outboards," Jack said, "maybe I can scare something up." Well, Dad gave him an old twenty-five that ran pretty good, and Jack hefted it over his shoulder and left the way he had come in. Dad said nothing, but he smiled and shook his head a little. I followed Jack clear down to the pier and out to his skiff. He knew I was following, but didn't say anything until he got to the skiff. He started hooking the engine up to the transom, then looked up and asked my name. I said it was Ricky, and I asked if those big wooden spearguns laying in the bow were his. He said they were, and asked if I would I like to see them up close. I said sure, and he waved me aboard.

At one time, those guns must have been a pretty sight, all varnished up and slick looking, but now they were chewed up with scrapes and scratches, and so many nicks you couldn't count 'em all. "I'll bet these spear guns have seen a lot of fish."

"Well Rick," he said, "that's a bet you'd win hands down. They've seen more fish than would fill the hold of that trawler over there." And he pointed to old man Hanson's fishing boat, the biggest on this side of the island.

"That'd be a lot of fish," I said.

"It is a lot of fish, Rick. Took a lot of years too. You ever think about being a diver, and getting your own food whenever you want it?"

"Yeah, I think about it all the time. My dad's pretty good with halibut, and he's starting to take me with him. I've seen a couple. Saw him spear one a couple of weeks ago. I never saw it sitting in the sand though. He pointed right down to it, and I couldn't see a thing until he speared it. Then it just took off, it was almost as big as me - not as thick, but just as wide. Have you speared any halibut?"

"Rick, I guess I've speared just about every kind of fish that's good to eat, except a broadbill. You know what a broadbill is?"

"Sure," I said, "it's a swordfish, but nobody's ever speared a broadbill. Have they?"

"Rick, I guess I've speared just about every kind of fish that's good to eat, except a broadbill. You know what a broadbill is?"

"Right again, Rick. Nobody's ever speared a broadbill. But I've been thinking about it. This year could be the year."

He winked at me, and his smile made me smile. He finished tightening down the engine, then plugged in the fuel line. "Let's see if this baby's got any life to her," he said, and with one arm, Jack pulled on the starter cord. He gave it three pulls, then choked it, and pulled again. She fired up.

Jack was always taking about big fish; who got the biggest back in this year and that. I think he had a couple of records of his own, but he never mentioned them.

"Untie my painter, will ya Rick. I'll see you around supper time." He idled out between the moorings to the mouth of the cove. I ran along the beach so I could see which way he headed. Jack swung west, kicking the engine up as soon as he cleared the moorings. He was out of sight in fifteen seconds.

That evening, an hour before sundown, Jack showed up again at the pier. I was waiting on the beach, and watched him pull in. He lifted two huge yellows out of the boat, and carried them down the pier and over to where my dad and some of the folks were milling around the tables, drinking beer and setting up the food. When they saw him coming no one said a word. He walked right up and said, "Where do you want these fish, Tyman?" That was my dad's name. He looked at Jack, and the two fish, that must have gone 30 pounds each.

"Hell, lay 'em down on this table, we'll fillet 'em right here. Ben, you start up the barbecue, we're going to be eating some fresh fish tonight!" Then he said, "Patty," that was my mom's name, "get this man a cold beer." Everyone was smiling and Jack took a long pull on his beer. He looked down at me and smiled and winked and said, "How ya doing Rick?"

I couldn't think of anything to say, so I just smiled back. I noticed that everyone was looking at Jack out of the corners of their eyes, both the women and the men. No one was too sure about him, except me and my dad. About the time we sat down to supper though, he was talking and smiling with everyone. Dad had told them about how he came walking into the shop with the outboard over his shoulder, and everyone laughed and called him "Outboard Jack."

We ate until our bellies were full to busting. Everyone found their way over to Jack and thanked him for providing all that fish. He said if he had known such a friendly gathering was having these cookouts, he'd have been making his contribution a long time ago. And they said if they had known somebody could get them this much fish, they'd a had these cookouts more often.

After that we started to have cookouts three times a week. Outboard Jack would come in with yellowtail, white sea bass, and calico, if we wanted it. My mom liked calico best, and he always brought her one. After dinner, the men sat around talking about the ocean, and the best places to find certain kinds of fish. They all knew the island like the back of their hands, but Jack knew it in a way nobody else did. He knew spots my dad didn't even know about. Of course, he was going after big yellows and whites, and most everyone else was satisfied with halibut and calico. Jack was always taking about big fish; who got the biggest back in this year and that. I think he had a couple of records of his own, but he never mentioned them.

Halfway through the summer, all the locals had heard about Jack. And they'd come down after the cookouts, nibble on the leftovers, and listen to the stories. I don't think we ever had more fun than that summer. Everybody was always ready to have a good time. Toward the end of the evening, after drinking a bunch of beers, Jack always turned the conversation around to broadbill. He would ask questions like, who was catching them, where they were catching them, and which boats were the best broadbill boats so he could go up and ask the skippers where the action was. Nobody put two and two together until later in the summer when the broadbill were starting to make their run.

One night my dad asked him straight out, "Why are you so interested in broadbill, Jack?"

Jack looked him right in the eye and said, "Cause I want to spear one Tyman, that's why I'm so interested."

"Hell, nobody's ever speared a broadbill."

"That's why I want to do it, Tyman, 'cause it's never been done."

My dad looked at him cold, and said, "You know why it's never been done? Because that's the meanest, toughest, most dangerous fish that lives in the sea, bar none. Hell, a broadbill sank a boat here about four years ago. Rammed it and started thrashing around until it tore the planking loose from the side of the boat and sank it. Them broadbill have leapt right into a boat's cockpit after the harpooners – killed a man on the east end ten years ago. Got him right through the chest, then somehow jumped back into the water and got away clean. Go look in the bar, there's a broadbill spike sticking right through a three-inch oak plank. Hell, you couldn't drive a nail that big through a piece of wood like that if you had all day."

All the time my dad was talking, Jack was smiling his smile, his blue eyes dancing. When Dad was through giving him all the reasons why he shouldn't even be thinking about spearing a broadbill, Jack said, "I figure we'll need about five hundred feet of thousand-pound-test line, and maybe three of those big red tugboat fenders to slow it down., Then of course, we'll have to get us a regular broadbill boat with a high tower so we can spot 'em in the water. We can have the plank out so I can slip overboard and put a spear into it before it knows what hit it. Then scramble back to the boat, and let it tire itself out on all that floatation.

My dad just looked at him, so did Dave and Ben and Bill. They all just looked at Jack like he was crazy. And Jack kept right on smiling. Finally he said, "It'll be fun. Everyone can come along, and help split the cost of the boat. You can bring Rick along. If nothing else, we'll have a hell of a fine day."

"You know why it's never been done? Because that's the meanest, toughest, most dangerous fish that lives in the sea, bar none..."

Then everyone started to smile and laugh and say, "Why not? We can always troll for tuna or something." Everyone except my dad, he didn't smile at all.

It took Jack about a week to get all the rigging he needed. He had to make a couple of trips to the mainland for the line and the big red buoys. We had reports that the harpooners

were getting broadbill pretty regular off the west end, about eight miles out. The time was right. Bill found us a plank boat, and were all set to shove off the next morning. Late in the afternoon, Jack stopped by the outboard shop to check up on some last minute details with Dad. I was there when he came in. "How ya doin' Rick, how's your dad this afternoon?" And he winked at me and smiled, "You all set for the big day tomorrow?"

He had me smiling and I said, "Yeah, I'm ready." And I looked over to Dad expecting him to be sort of excited, but he was real serious.

He said, "Jack, I wish to hell you weren't doing this. Anything could happen; you know that. A fish like that can swim 30 knots, probably more. A line could catch you and take you down so fast you'd never make it back to the top. Never mind if it decided to turn on you like it does to fishermen. Why, it'd cut you to ribbons. Those fish are averaging close to a thousand pounds off the west end - you wouldn't have a chance in hell. We couldn't do a thing for you up in the boat."

"I appreciate your concern Tyman, but I believe I got this all worked out. You're right, the important thing is to stay clear of the line. That mother is going to be whipping about something fierce. Soon as I take the shot, I'll bail out on the opposite side the fish is heading. Then I'll get back to the boat as quick as I can. We can hang a knotted line up front, on the opposite side the line is fed out, and the boys can haul me up. Hell, we probably won't even see a swordfish. You know how that can be. You've done your share of broadbilling."

"Yeah, I've seen enough of them, and for your sake Jack, I pray we don't see any tomorrow."

The next morning was bright and clear, not a cloud in the sky. Jack picked us up in his skiff, and had to make six trips to the plank boat to load up all the people and gear. We headed for the west end, and got there around nine. About a mile offshore we starting taking turns up in the tower looking for a broadbill basking on the surface. Dave went up first and spent a half hour, then Bill joined him. When they came down, they said it was hard staring out at the shimmering water – your eyes got to hurtin' after awhile. The morning was the best time to look before the wind came up and raised a chop. When Ben came down, it was my dad's turn, and he took me up to the tower with him. I couldn't believe how high we were. The boat was rockin' and I got scared. Dad said to relax and I'd get used to it. Before long, I forgot about it and was just looking out across the ocean. Dad said to look for a slight break in the glass of the surface.

At first it was fun, then it got to be work. You'd strain so hard to find something that pretty soon your eyes started aching. We were about ready to come down when I thought I saw something off the left and pointed without saying a word. Dad looked, and sure enough, it was a broadbill. He yelled down, "Big fish to the southeast." Everyone on deck started running around, trying to see. We climbed down when the skipper got a fix on the fish and started moving toward it real slow.

The skipper called out, "Fifty yards," then "forty, thirty, twenty." The boat stopped and Jack slipped into the water...

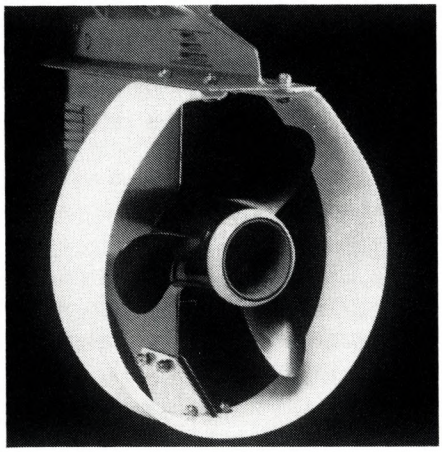
Jack was ready to go when we got down. He had on his wet-suit and his big wooden speargun was already cocked. All that line was coiled neatly on the port side of the boat. Everyone came by and gave him a pat on the back, but didn't say anything. I started feeling sick, I was so nervous. Dad was the only one who talked to him. He said, "Don't forget that line Jack, get clear of that line."

Jack nodded, looked at me and smiled. He gave me a thumbs up. The skipper called out, "Fifty yards," then "forty, thirty, twenty." The boat stopped and Jack slipped into the water. Everyone watched off the starboard bow. He swam toward the fish until he was about 40 feet away, then made his dive. About ten seconds later the fish exploded taking line like a runaway freight train. They all waited for Jack to pop up, but he didn't. The fish kept taking the line until it was gone, and all the floats were released. Still there was no sign of Jack.

We tracked the buoys into early afternoon, then began hauling them in. The skipper had called the Coast Guard to report a missing man. They came out with their helicopter, but I knew they wouldn't find him. When all the line was hauled up, Dad spotted a brown stain about thirty feet from the end of the bent spearshaft. The fish had got off. Dad held the line in his hand and said, "Must have wrapped around an ankle or arm and took him down."

I cried most of the way back. Jack just seemed too big to die. I couldn't see how anything in the sea could kill him, not even a broadbill. Dad said I was right. "It wasn't the sea that killed him, it was himself. He went after that broadbill for all the wrong reasons. There was no need for it. It's one thing to feed yourself and your friends, and it's another to kill something just for bragging rights. Jack was wrong in that, and it killed him."

They never did find Outboard Jack. I don't think he's dead. He was a strong swimmer, he could have made it to the mainland. Probably got picked up by a boat or something. Probably said the hell with it, I've had enough of the sea. I don't expect to see him. But every summer when the whites and yellows start running, I look for him anyway. He'll probably show up one of these days when I least expect it.



The Prop-Mate Prop Guard

Review by Al Bruton

I dive a great deal, often several times a week and most of my dives are from a boat. Boat diving allows me a greater range of diving locations and activities, and because of my work, I spend hundreds of hours each year operating my boat in every imaginable location and set of water conditions. It also means I spend lots of time at launch ramps and almost every time someone sees my boat they ask the same two questions. "What is that thing you have over your propeller?" and "Where can I get one"?

I have is a Prop-Mate prop guard, on my 17' Boston Whaler with a 70 hp Yamaha. The prop guard provides enhanced performance in several key areas of vessel operation. The boat comes out of the hole (acceleration from dead in the water or at slow speed) and onto plane much faster with the guard, and it also stops faster. I find that I can turn more sharply and maintain better control in turns and the vessel steers or tracks on a straight line better, especially at slow trolling speeds, which is aids in navigation.

The guard provides lower unit and prop protection. If you run onto the beach or against rocks your prop and cavitation plates are not destroyed. I gave this the ultimate test two years ago running down stream on the upper Sacramento River. I was running full speed with a 12 knot following current when I hit a rock and gravel bar at more than 40 mph. My boat sustained minimal damage and I was able to continue the job I was on for the next two weeks without repairs.

The guard provides protection for swimmers and divers in the water. I consider this to be the most important aspect of the guard. I was a Lifeguard Lieutenant for 26 years for the City of San Diego, and we developed prop guards in 1978 for the protection of swimmers, divers and lifeguards in the water. Today, almost every major lifeguard service in the world uses prop guards on their surf rescue vessels. Every year people are accidently struck by these vessels and, because of the prop guard, escape serious injury. I've even been hit by my own boat, when someone else was operating it on a dive site, without injury from the prop. I consider the Prop-Mate a necessity for my vessels.

The two largest arguments against prop guards are voiced by the manufacturers of outboard engines. The first argument is that the guards will lessen performance, especially top-end speed. I have participated in two sets of extensive testing with the guards and the results prove this false. Performance has been shown to improve and my boat travels 1-2 mph faster with the guard.

The second argument is that fuel consumption increases with a guard. While this is true, the increase is only two to three percent. During a normal day of boating and diving activities, this small increase is hardly noticeable.

Prop-Mate makes guards for all outboard engines up to 70hp. The guards are not expensive and simple to install.

As a boat owner, you should seriously consider a Prop-Mate guard for your engine. The performance, protection, and safety to divers and swimmers you gain is worth the small investment.

Prop-Mate is located at 1944 Gotham St, Chula Vista, CA. 92103, and they can be called directly at (619) 421-6521. Ask for Bill Flood. He is friendly, helpful and truthful – a rare combination!

Wenoka Reeflex Fins

Review by Jolee Brunton, Ph.D.

Wenoka introduced a new concept in fins last January. The Reeflex fin is the first to offer adjustable blade tension to allow a diver to make the fin stiffer or more flexible. These fins can be adjusted to accommodate a diver's strength or conditions. The fins adjust by adding up to three battens, each increasing tension by five pounds of thrust. Tension can be increased from 15 pound with no batten, to 30 pounds if all three battens are used. Stiff fins require more muscle strength, so a diver can tailor these fins to current strength, and add more as he/she develops a stronger kick.

In addition to adjustability, the Reeflex fin has several other feature that enhance performance and comfort. The fin blade has a slight cup molded into it. This acts much like a swimmer's cupped hand, grabbing hold of the water. The tips of these fins are floppy, which allows the fin top to change direction rapidly during a kick, adding a little whipping thrust. The foot pockets on this fin are very comfortable as the bottom of the pocket extends back onto a diver's heel, making for a secure fit. Another nice feature of this fin is the strap adjustment. The straps clip to the fin via a hole on the strap that slips over a knob on the fin. It is very easy to fasten and unfasten. The fins can be easily adjusted while being worn by flipping up the ad-

justment bar and pulling the fin strap through. While it is very easy to adjust this fin, even under water, the straps do not slip once the bar is in place. Finally, the foot pockets fit women's feet. The arch is high enough to be comfortable without being cavernous.

Swimming with this fin is a pleasure. The fins are light without being annoyingly buoyant. They have a good snap to them and add power to the kick, increasing efficiency and speed. At 15 pound of tension they were very comfortable and forgiving, but not quick. The difference at 30 pounds was very noticeable, being much stiffer and more demanding, but with an accompanying increase in thrust.

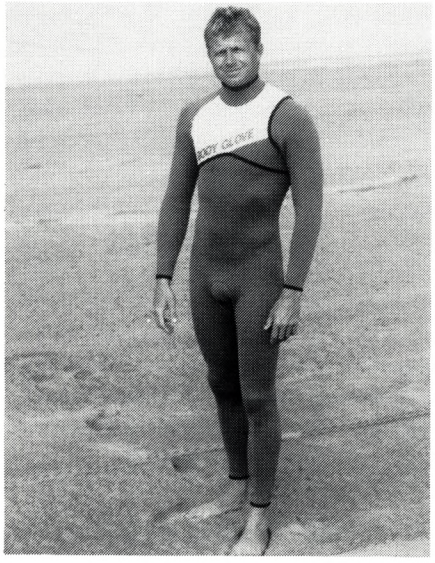
While in the Solomons I dived over 40 dives using these fins and was extremely pleased with their performance. I did, however, have a couple of criticisms. First, 30 pounds of maximum tension did not make the blades stiff enough for some of our divers. Wenoka anticipated this and has developed stiffer battens which will be available in 1991. Second, they scratch and mar very easily. After 40 dives the fins looked worn, especially when contrasted with a pair of old reliable ScubaPro Jetfins, veterans of 140 plus dives. It's a tradeoff-the comfort of new lightweight materials for the endurance of a stiff rubber fin.

Wenoka has a very good product in the Reeflex fin. They will be improving for 1991 by increasing the adjustment battens and adding new batten, blade, and buckle colors to coordinate with other dive gear-hot lime, hot pink, black and blue. Suggested retail is $99.95.

Body Glove 1.5 mil No Zip

Another new product tested during the Solomon trip was the Body Glove 1.5 mil No-Zip wetsuit. Previously available in 6mm and 3mm neoprene, this thin new suit was developed specifically for tropical waters. It is an alternative to Lycra suits which afford protection from nicks and scratches, but have no thermal qualities.

The waters off the Solomon Islands were a balmy 83 degrees, but with bottom



times averaging over an hour on each of our four or five daily dives, the thermal protection of the 1.5 mil suit was appreciated. It was thin enough to be comfortable while suiting up and at the beginning of the dive, but thick enough to sustain body temperature throughout long dives. Although it is a neoprene suit, it is thin enough that very little additional weight is necessary to compensate for the buoyancy of the suit. I added only one additional pound to the weight previously used with a Lycra suit.

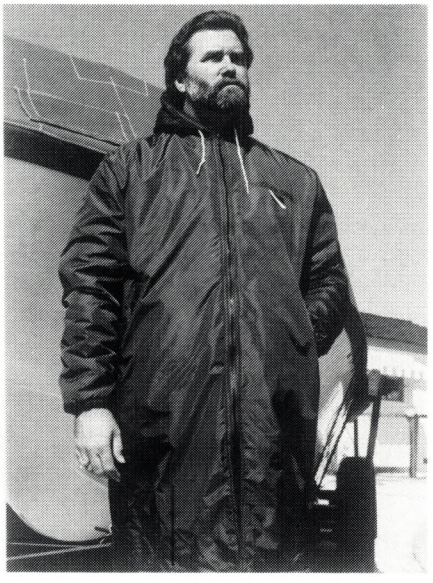
The lightness of the neoprene, coupled with the flexibility of the No-Zip design makes this an extremely comfortable wetsuit. Other features of this suit include Velcro shoulder locks, glued and blind-stiched seams, and Lycra trim tape on the suits edges. It is an attractive suit, and nicely finished.

In the past when diving with Lycra or neoprene suits with zippers, especially on vacations when diving several times a day, the zipper would chafe and rub the skin around the neck. The No-Zip (for obvious reasons) takes care of this problem.

truWest Custom Parkas

If you're tired of being cold between dives, or want to completely decrease the wind chill on a fast boat with a wet wetsuit on, then the truWest Parka is for you.

A parka with a super quality tight weave of 70 denier neoprene coated with a nylon shell makes it completely waterproof, not just water-repellent. It is lined in with a plush pile that adds to the comfort and warmth and the triple stitching reinforces the seam construction. The three-quarter length allows maximum protection from the elements and, the two-way non-corrosive zipper makes it easier to put on and take off. The truWest Parka is machine washable, comes lined or unlined, and is available in 16 outside shell colors with the option of 10 inside pile lining colors. Custom embroidery and lettering is available upon request.



The parka we used kept us warm as promised by truWest. We tested this parka between dives in San Diego aboard a very fast boat. To test the water-repellent features of the parka, it was worn in the shower (since it never rains in southern California) with dry clothes on. The parka kept everything underneath it dry and protected.

The truWest Parka is a great comfort item to add to your diving inventory that will keep you warm and dry. Sizes range from XXS through XXXXL with the cost ranging from $85 to $110 depending on size. For more information contact your local dive retailer or call truWest at (800) 451-8401 (CA), (800) 322-3669 (national) for a retailer near you.

NEWS BRIEFS

News Briefs are a service provided to the diving community. If you have information you would like to share with other divers, this section is available to you at no charge. Releases should be concise and limited to 150 words. Publication of the Newsbrief is not necessarily an endorsement of the item by *Discover Diving*.

12th Pacific Coast Underwater Photographic Championships

Discover Diving, in cooperation with The San Diego Council of Divers, Inc. is pleased to present the 12th Pacific Coast Underwater Photographic Championships, to be held in San Diego, California August 10 & 11, 1991.

This competition is open to all underwater photographers. Judging will be by division in Novice, Amateur and Advanced. Competition categories will be: Marine Life, The Diver and Macro Photography. Entrants will have from 6:30 a.m. to 2:30 p.m. (8 hours) to expose one roll of Fujichrome ASA 100 film. Photographs may be taken anywhere in the Pacific Ocean. You may use boats, floats, or any other legal form of transportation to reach your dive destinations. ***Discover Diving*** and the San Diego Council of Divers will not be providing transportation to and from dive sites. Film not returned by 2:30 p.m. will not be judged.

Entry fees include film, processing, judging, awards & door prizes and the Saturday evening dinner party. The entry fee is $45. With proof of membership to the San Diego Council of Divers, the entry fee is $30 and with proof of membership to any of the other California Councils is $35. For additional information and rules call or write: ***Discover Diving*** (PCUPC), P.O. Box 83727, San Diego, CA 92138: (619) 697-0703.

New Dive Chocolates

Super Dive Super Chocolates are the first of many exquisite products planned for the enjoyment of the diving community. Everyone likes to have items which reflect their participation in a particular sport. On special occasions we all like to give and receive gifts related to our passions. Super Chocolates have been created to satisfy these needs. They are an affordable product that divers can have fun giving, receiving, and eating while diving, or while dreaming about going diving. Available through retail dive stores, dive boats and dive resorts in either our gift pack or in bulk, try a Super Chocolate or two during your surface interval, it is a sweet way to pass the time. Dealer inquiries welcome. For additional information, call Super Dive at (619) 945-2887.

Sea Quest Supports New Compression Study. TakesPlace on World's Oldest Ship Wreck.

Dr. Caroline Fife M.D., a DAN Physician from Duke University's F.G. Hall Hypo/Hyperbaric laboratory, recently combined extensive doppler testing with the documentation of detailed dive profiles during the excavation of the world's oldest known shipwreck. Sea Quest, Inc. provided Dr. Fife with Suunto SME-ML dive computers for the specific purpose of recording the detailed dive profiles of the underwater archaeologist working on this wreck. The ancient ship lies off the southern coast of Turkey, near the village of Kas. It rests on a deep slope between 140 and 180 feet of water. Excavating the delicate artifacts in such deep water produced many problems and because of the nature of the excavation, scuba was the only viable choice.

Special repetitive tables using oxygen decompression were developed, so the Suunto SME-ML's were used only as dive profile recorders and not as decompression meters. Working at these depths was only possible under strict supervision. The SME-ML's dive profile recorder became the 'little black box' recording information for the purpose of Dr. Fife's study. Doppler scores were combined with the detailed recordings of each dive profile. Among the discoveries important to the diving medical community include observations of how the body reacts to repetitive dive schedules. The Doppler testing conducted by Dr. Fife was the most extensive study of repetitive multi-day open water air dives to date. According to Dr. Fife, "In order to carry out this study it was necessary to document the exact dive profile of each scientific diver included in this study... The Suunto dive profile logger is the only commercially available instrument which was practical for this purpose." For more information concerning the SME-ML dive computer, contact Sea Quest, Inc., 2151 Las Palmas Drive, Carlsbad, CA 92009, (619) 438-1101.

Dive New Jersey... and Beyond Dive Symposium

On Saturday, November 10, 1990, the New Jersey Council of Diving Clubs will present its 14th annual "Dive New Jersey... and Beyond" Dive Symposium at the Ocean Place Hilton Resort and Spa, in Long Branch, NJ from 9 a.m. to 5:30 p.m. For additional information, call Dick Norton at (401) 572-3121.

Jim Church Leads U/W Photo Courses on Aggressor

Jim Church starts the new year with three multi-level underwater photography courses: January 19-26 - Antilles Aggressor; January 26-February 2 - Bay Islands Aggressor; and February 23-March 2 - Cayman Aggressor. For beginning to advanced still photographers, contact Aggressor Fleet Limited at (800) 348-2628 for additional information.

SSI Introduces New Dive Tables

The leader in scuba educational products, Scuba Schools International, introduces a new and improved version of the U.S. Navy Dive Table. The new dive tables, constructed of sturdy, laminated plastic feature the Doppler Limits in red to increase the awareness of the importance of diving within the recommended limits for recreational divers. A gray screen also serves to warn divers when planning dives outside the Doppler Limits.

A lighter, more visible yellow ink, as well as the enlarged artwork, make reading the tables easier and less constraining to the eyes. The waterproof tables are 7" x 41/4" and are holed to fit into any SSI log book binder. The U.S. Navy Air Recompression Tables are featured on the back of the tables.

Call For Papers CAUS Diving For Science 1991

The CAUS symposium and annual general meeting will be held Friday, April 12, 1991 at the Constellation Hotel in Toronto, prior to the opening of Underwater Canada. The CAUS is now requesting the submission of papers for the 1991 symposium. Contributions are welcomed in, but not limited to, the following areas: Diver Training/Safety, International Scientific Diving, Medical Aspects, Physiology (Health and Safety), Techniques and Methodology. If you wish to present a paper, please provide a brief, 8-10 line abstract (max. 250 words) which summarizes the major findings of the paper to be presented by February 1, 1991. Send abstracts and requests for program information to: Neal Pollock, Occupational Health and Safety, University of British Columbia, 2075 Wesbrook Mall, Vancouver, B.C., V6T 1W5; (604) 228-2990 or FAX (604) 228-6650.

Dacor Introduces New Masks

Dacor Corporation recently introduced the Accord™ and Mini-Accord™ mask to its product line. These new lightweight masks have a soft, double feather-edge seal which contours to a greater variety of faces. Both masks feature a push-button strap lock which allows for easy one-hand strap tension adjustment. These moderately priced masks have a single tempered lens for improved downward visibility. The masks are available in a variety of colors in both clear silicone and black rubber. The Mini-Accord™ is approximately 15% smaller than the Accord™ and is sized to fit children and teens with narrow faces. For more information, please contact your local Dacor dealer or Dacor Corporation at (708) 446-9555.

New High Speed Shafts From JBL

Prompted by growing demand from Hawaii and other spearfishing areas, JBL has added special high speed shafts to its already extensive product line of spearguns, polespears and accessories.

New High Speed Competition Shafts - Spring stainless steel shaft, 9/32" diameter is available either with "threaded end (6mm)", or "dart-pointed end wing". Available in two lengths, 48" and 60", the new shaft will fit standard JBL guns which take this size shaft. For more information, please contact JBL at (714) 633-0860.

Drysuit Diving Workshop at Cal State Long Beach

On Saturday, December 1, the California State University, Ocean Studies Institute will sponsor an all day Drysuit Diving Workshop on the Cal State University, Long Beach campus from 8 a.m. to 4 p.m. Steven Barsky, author of the **Dry Suit Diving Manual** will present a variety of information related to drysuit diving techniques and safety, drysuit maintenance and repair, and how to select the drysuit that best meets your needs. Several drysuit manufacturers will make suits available for workshop participants to try out in the pool, to practice some drysuit diving techniques and compare the different kind of suits. For more information, call (213) 985-7588 or (213) 985-5343.

NAUI COLLEGE Announces New Courses

Due to popular demand, NAUI College has opened a new section of its Professional Course which will be offered from November through January. The three month program is designed to prepare a serious diver to become a full-time professional instructor and manager in the industry. Additionally, one month Advance Instructor courses are now available. The Advanced Instructor Course offers the regular ITC plus additional specialty programs. For more information on these as well as other course offerings, contact NAUI College at (800) 423-7095 or (714) 833-9337; 4100 Birch Street, Suite 100, Newport Beach, CA 92660.

Roatan Named International Airport

The MV Isla Mia, a member of the Bay Islands Tourism Association (BITA) is proud to annouce that the Roatan, Bay Islands, Honduras airport has been officially declared an International Airport. During 1990, BITA (composed of seven major Bay Islands resorts, fours small hotels and two live-aboard dive boats) contributed to the salaries and living accommodations of the 22 employees needed to put the airport fire and rescue departments and control tower into operation. As a result of this support and meetings held with government, the airport was officially declared international by a presidential decree signed by President Rafael Callejas. BITA Resort members are Anthony's Key Resort, Fantasy Island Beach Resort, Coco

View, Romeo's Resort, Bayman Bay and Posada del Sol. Hotel members are Buccaneer Inn, French Harbor Yacht Club, Plantation Inn and Cay View. Live-aboard dive boats are Isla Mia and Bay Island Aggressor and Bay Island Tour and Travel. For more information concerning BITA you can contact the Isla Mia at Route 6, Box 508, Montgomery, TX 77356; (800) 874-7636.

Len Tillim Leads Tour to Fiji

Noted underwater photographer, Len Tillim, in conjunction with Adventure Express Travel of San Francisco, will be leading a photo/dive trip to Fiji in 1991. The trip will be based at KADAVU, the fourth largest island in the Fijian chain, and will be geared toward the photography of the underwater environment of this tropical paradise. The trip dates are August 22-31, 1991. For more information call Len Tillim directly at (213) 973-5175 or Adventure Express Travel at (800) 443-0799. Space is limited for this once in a lifetime photo opportunity.

Ocean Quest to Replace Ocean Spirit

Ocean Quest International, operator of the dive/cruise ship M/V Ocean Spirit, has been notified by the owner of this vessel that the vessel has been sold. While the name of the new owner has not been released, the owners did indicate to Ocean Quest International that the buyer was not considering using the vessel for a scuba diving operation.

Emmanuel Georges, President of Ocean Quest International, stated they are currently looking for a new ship that fulfills their criteria for an ocean going scuba diving complex and water sports resort, and to expect an announcement regarding the new Ocean Quest ship in the very near future.

Helmet Mounted Dive Light

Have you ever tried putting a lobster into your game bag with one hand while holding a flashlight in your other hand? Difficult, right? Well finally there is a powerful, helmet mounted dive light that provides hands free light wherever you look. With this new wide angle dual light system you'll perform any task underwater far better than when encumbered with a hand held dive light.

Waterproof to 300 feet, the NR 4000-D model of the NiteRider product line was designed especially for deep water scuba diving, night diving, caving and wreck diving. This powerful system uses high wattage halogen lamps in power ranges from 20 watts up to 250 watts. A 3-way toggle switch allows switching between the low and high beam or to have both lamps on simultaneously. The helmet is comfortable and lightweight, fits well around any dive mask and provides head protection when diving in tight spaces. The rechargeable 4.9ah nicad battery pack is available in weightbelt, BC or tank mount. A remote switch with a coil cord allows easy on/off switching. Available from NiteRider Light Systems, 991-C Lomas Santa Fe Drive, Solana Beach, CA 92075; Phone (619) 792-8366.

Waterman, Father & Son, Win "Emmy" Awards for 1990

Stan Waterman and his son Gordy were both awarded "Emmy's" for their cinematography in the National Geographic Explorer segment, Dancing with the Stingrays. It was a fourth "Emmy" for Stan and a second for Gordy. Lisa Truitt, a former Our World-Underwater Scholarship winner, was the producer for the series. Famous underwater photography, David Doubilet, and the stingrays of Grand Cayman were the subject of the segment.

St. Claire Introduces Gage-Gard™

St. Claire is pleased to introduce the Gage-Gard™, a protective grill designed to safeguard gauge and decompression computer lenses from scratches and breakage. The Gage-Guard™ lens protector is made of non-magnetic staimless steel. It prevents objects from scratching or breaking lenses, while not interfering with the reading or the access of the special features of computers. It is also easy to install, just snap it on. It comes in a variety of sizes to fill all major manufacturer's gauges and computers. Gage-Guard™ lens protector has U.S. and foreign patents pending and is manufactured exclusively for St. Claire by Alloy Marine Products, Inc. Dealer inquires should be addressed to: St. Claire, 544 Marin Avenue, Mill Valley, CA 94941; (415) 383-4826.

New Dive Wetsuits from CASAD

Casad Manufacturing Corporation has added a diving line to their ever popular wetsuit line. The new dive wetsuits are 3 in 1, made with 3mm neoprene, seam taped with waterproofing, with matching shorty and sleeveless fullsuit, blind stitched, glued, and seam taped inside. Available in black, green, or lemon body with a hot color accent. The women's 3 in 1 has all the same features, and also has a flattering princess line to accentuate the female figure. Call your nearest Casad dealer, or the Casad Sales office at (419) 394-7478.

MetroWest Dive Club Formed

Over 80 scuba divers located in the metropolitan west area of Boston have teamed up to form The MetroWest Dive Club. The clubs aim is to promote recreational scuba diving along the coast of New England. For additional information, please contact Julin Conlin at (508) 443-3726.

New Regulator from Scubapro

Scubapro has just released their latest high tech Second Stage Regulator... the D350. It is a further design and performance enhancement of the very successful D300 Regulator, considered by many seasoned divers to be the ultimate regulator. The advanced regulator has a new high cam demand valve lever, which improves flow rates at depth. Valve seat wear has been reduced even further through the use of new low compression silicon seat materials and a redesigned orifice angle. The cap has been redesigned with a stronger thread configuration. See your local Scubapro dealer for more information.

Advertiser Index

Classifieds

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Video: Hear an authority speak to you/your club about **Decompression sickness.** Dr. Chris Dueker talks on video, 78 minutes. Send $25 check to Diving Safety Digest, P.O. Box 2735, Menlo Park, CA 94025. Limited offer.

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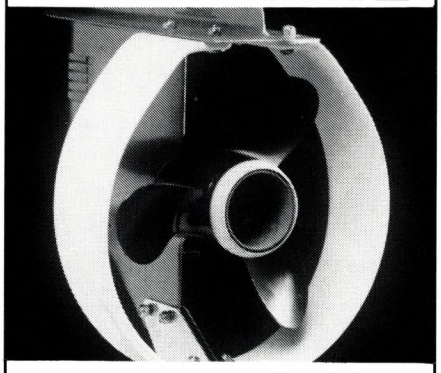

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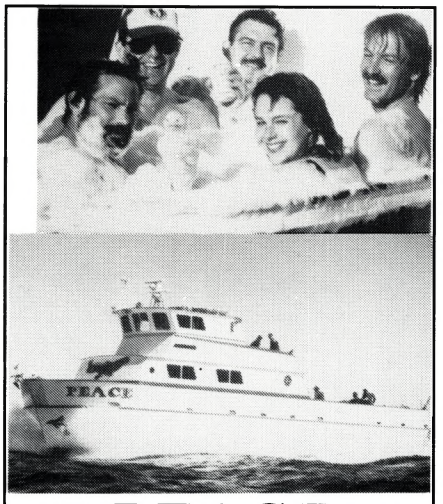

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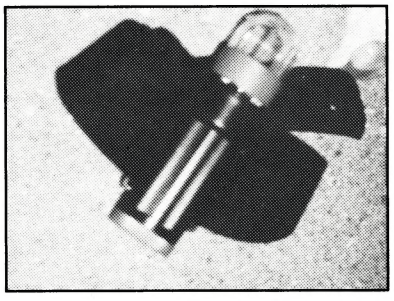

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Never ruin a dive again because of a lost buddy in low visability or night dives. The Mini Strobe can be worn on the arm, leg, or attached to the tank.

5 inches long and weighing 5 oz., this high visability strobe is also great for:

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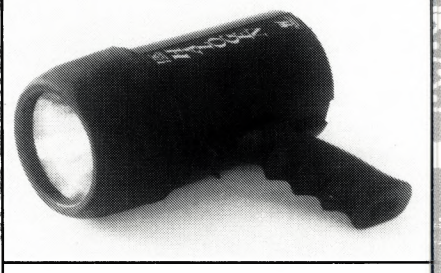

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At 14 watts, it's the brightest alkaline powered dive light made. The UK1200 Halogen will run up to ten hours on a set of eight alkaline D-cells, and has a suggested $75 retail price. Available at your local dive retailer or by contacting Underwater Kinetics at (619) 744-7560.

Underwater Kinetics

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A Lesson in Night Diving

by Bill Paul

It was to be our last boat dive at night for the summer, and we were anxiously looking forward to it. We were diving with a local shop on the big island of Hawaii. We inquired about the use of cyalume light sticks at night and much to my surprise, we were told that they weren't necessary, but if we wanted to use them we could. If my wife and I had been more experienced at night dives that casual approach would have raised some serious questions about the safety orientation of the dive operation.

My wife Bobbi and I were certified in March 1990 in the cold murky waters off San Diego, California, and at age 53, I was wondering about the wisdom of this new sport. Now with warm water, no encumbering wet suits, and our new lightweight BC's, that rigorous cold water training was just a vague memory. We had already completed several night dives and all the anxiety was behind us, and we were really looking forward to our 43rd dive.

It was the 22nd of August and this night dive was to help ease the pain of Bobbi's birthday (the big one!). After thirty years of marriage we decided this was not the night to be separated, so we brought our cyalume sticks as well as our own night lights. We left Honokohau Harbor on the boat with ten other divers and headed north several miles to Kaloko Point. We were given a short briefing on the dive site and a review of light signals. (Incidentally these signals were different from those used on dive boats in our area.) We were also informed that there was some kind of stinging night worm that was attracted to the surface lights, so upon finishing the dive, we were advised to get out of the water quickly. This information left me a little nervous.

Since Bobbi and I were "experienced" we were to enter the water first. I jumped in and upon surfacing and getting turned around, found myself about 30 feet from the boat in a strong current. Bobbi jumped and came up almost next to me. One of the two dive masters told us to swim back. I told him about the current and that we would descend and meet him and another couple on the bottom. I was a little concerned on the surface, but on reaching the bottom at 40 feet in a slight depression, found the current not much of a problem. Soon, the divemaster and the other couple joined us and we were led north to a depth of 30 feet where the current was so strong Bobbi and I could no longer make any progress no matter how hard we tried. I found myself breathing too hard, so I signaled Bobbi to turn back, and we were immediately swept effortlessly back to the depression under the boat. I decided to finish the dive in a small safe radius beneath the boat, and promptly forgot about the current while exploring.

We had been told to surface with no less that 700 psi, so with 800 psi and bottom time of 39 minutes we started our ascent. At fifteen feet we made our three minute safety stop with our backs turned to the underwater strobe so we could monitor our depth gauges without the blinding flash. With our timers showing 43 minutes we surfaced, and to our surprise found ourselves about an eighth of a mile from the boat. We gave an okay signal with our lights and started to kick back. Bobbi later said that she had seen a reply light from the boat which I missed. We soon realized that our hard kicking was only slightly slowing the rate we were drifting away into the very dark night and I started to worry about what it would be like to spend the night in the water - no wet suits and those nasty little stinging worms.

Even though the water was smooth, after about half an hour we could no longer see the boat, so we used our whistle to signal and found out later it was never heard. With the onset of a slight chill and hint of leg cramps, you can imagine the relief I felt when I finally heard the engine start up and saw the red and green bow lights coming toward us.

Safely on board we found out that the other divers all had severe problems with the current and getting back to the boat. Two divers, who entered the water last, with no previous night diving experience, had been immediately swept away because of the strong current. A divemaster went in to help, but was unable to get them back to the boat. Being on the surface during the entire dive operation, the three were found considerably farther south than where we were picked up. (Incidentally, the two divers were refunded their money.)

With some time to reflect on that last night dive, I have come to some personal conclusions. Never dive at night without cyalume light sticks. We were the only divers with them, and if the other lights had failed, I seriously doubt they would have been found before morning. Wear some type of thermal protection at night, if for no other reason than to protect from those stinging critters. Ask for a drift line to be placed in the water before the first diver enters. Make sure night signals are understood, and have the divemaster explain what will happen if you are separated from the boat. Try to find a dive boat that has an auxiliary boat in the water ready to go if a diver gets in trouble day or night. It's not always possible to pull anchor with other divers still in the water. Always ascend holding onto the anchor line, and last, don't be anxious to be the first one in the water, especially when in a new area.

Two days after the dive I spoke to the dive operators about our experience and was gratified that they were already working to see that none of their future clients would repeat our experience. It was also encouraging to me that they wanted my input about the dive and really cared. I'm sure that when we get back to Hawaii, we will be out diving with them again. Birthdays come and go, but for Bobbi's 50th, I'm sure neither of us will soon forget floating together in the dark off Hawaii's Kona coast.

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